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MINOR SURGERY.

ON

BANDAGING,

AND OTHER

OPERATIONS

OF

MINOR SURGERY.

BY

F. W. SARGENT, M.D.,

MEMBER OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA; ONE OF THE SURGEONS TO WILLS' HOSPITAL, ETC. ETC.

NEW EDITION,

WITH AN ADDITIONAL CHAPTER ON MILITARY SURGERY,

By W. F. ATLEE, M.D.

AND

ONE HUNDRED AND EIGHTY-SEVEN ILLUSTRATIONS.



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TO

GEORGE W. NORRIS, M. D.,

SURGEON TO THE PENNSYLVANIA HOSPITAL,

AS A TRIBUTE OF RESPECT

FOR HIS PROFESSIONAL AND PERSONAL CHARACTER,

AND IN ACKNOWLEDGEMENT

OF HIS INSTRUCTIONS AND REPEATED KINDNESS,

This Volume

IS INSCRIBED

BY THE AUTHOR

PREFACE TO THE NEW EDITION.

THE very kind manner in which the first edition of this little book was received, has stimulated the Author to renewed diligence in adding to it whatever seemed to him calculated to augment its usefulness and its comprehensiveness. He hopes that his efforts will be found successful.

By an increase in the size of the page, it will be seen that the considerable additions to this edition have been introduced without causing any enlargement of the volume.

PHILADELPHIA, 1855.

The merits of the work as a handy and convenient manual for reference in the field and hospital, have induced the publishers to add to it a chapter (the Ninth) on Gunshot Wounds, and such other subjects peculiar to Military Surgery as seemed requisite to adapt it more thoroughly to the wants of Army Surgeons. Owing to the absence of the Author in Europe, this has been prepared by Dr. W. F. Atlee.

PHILADELPHIA, March, 1862.

PREFACE.

THE object which the Author has had in view in the preparation of the following pages, has been, to present to the younger surgeon, and to the student, information relative to the art of bandaging, and to some other points of importance in the practice of surgery. These are subjects which are but slightly alluded to in systematic courses of lectures, or in most of the published treatises on the science; yet the necessity of a familiar acquaintance with them will be readily acknowledged by every surgeon of experience.

In the collection of the materials for this volume, the Author has availed himself very freely of the knowledge of others, as exhibited in books, and of his own opportunities in hospitals and in private, of gaining practical acquaintance with the subjects of which he has treated. He trusts that he has not failed in his intention, always to give due credit to all from whom he has taken information. Originality can scarcely be expected, in a work of this kind, excepting, perhaps, in its composition.

The book is divided into five parts. Of these, the first embraces a description of the implements, if such a term be admissible, with which the ordinary duties of the surgeon are accomplished.

The second treats of the composition and preparation of Bandages, of their application to the different regions of the

body, and of the purposes which they are thus made to subserve.

The third is devoted to the consideration of the apparatus of various kinds, used in the treatment of Fractures. In the arrangement of this portion of the volume, the Author has thought it expedient to give pretty full details, showing the indications of treatment in each particular case of Fracture, and thereby rendering more manifest the adaptation of each bandage, splint, or other dressing, to the fulfilment of these requirements.

The fourth division describes the mechanical means employed in the treatment of dislocations, with the mode of applying them.

In the fifth part are detailed at length the methods of performing such operations as seem strictly to be included in the term "Minor Surgery;" these are the operations for bleeding, general and local; the modes of effecting counter-irritation;—the methods of arresting hæmorrhage; the closure of wounds; the introduction of the catheter, and the administration of injections. A few remarks on the mode of relieving pain during operations, and a short appendix of useful formulæ, close the volume.

PHILADELPHIA, May, 1848.

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MINOR SURGERY.

PART I.

THE means employed by the surgeon in the treatment of the diseases to which he is ordinarily called, should first engage our attention: they are, in a measure, of a mechanical and chemical kind. This part of the volume will therefore be devoted to the consideration:

First. Of the instruments which it is most necessary to provide for daily use.

Second. Of the materials employed for surgical dressings, and the mode of applying them,—including the use of water as a local application, and for bathing.

Third. Of the means of purifying the atmosphere of the patient's apartment.

CHAPTER I.

ON THE INSTRUMENTS USED IN DRESSING.

THE instruments which the daily avocations of the surgeon call for are of various kinds. For convenience-sake they are arranged in a "pocket-case." They may be multiplied according to the fancy of the surgeon; but those which will be found most useful are, the dressing and dissecting forceps, a pair of scissors, bistouries, scalpels, a thumb-lancet, an abscess lancet, a director, probes, a tenaculum, curved needles, a porte-caustic, a double catheter, and ligatures.

The uses of the dressing forceps are manifest, in the removal of soiled dressings, covered, as they very often are, with acrid and irritating secretions; in the loosening and withdrawal of decayed bone, and other foreign matters, from sinuses, deep wounds, and such points as are of difficult access to the fingers alone. For such purposes the common dissecting-forceps will frequently answer. But the proper *Dressing-forceps* is of a more suitable shape, as illustrated by the accompanying drawing (fig. 1). A still better form is that of

Fig. 1.



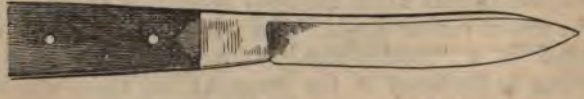
the French *Polypus-forceps*, the blades being bent in front of the pivot, so that the instrument occupies less space in the wound or sinus, when opened than when closed.

The scissors used by the surgeon may be straight or curved.

There should be two bistouries in the pocket-case: a sharp-pointed and a probe-pointed. The circumstances in which each will be most advantageously employed, will readily suggest themselves to the operator.

There is great variety of opinion as to the best form and

Fig. 2.



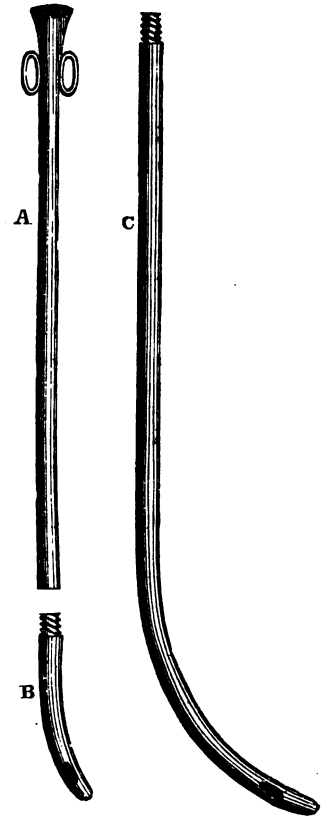
size for the *Scalpel*. Mr. Fergusson prefers one of the shape and dimensions indicated in the annexed drawing (fig. 2), the blade and handle together being about six inches long. With such a scalpel in his pocket-case, one may perform almost any

of the capital operations of surgery, so far as mere cutting is concerned.

The director and the probes should be of silver, as being flexible, and less liable to be injured by contact with the various fluids with which they will meet, than if made of steel. The probes should be of various sizes, and one should be made with an eye in its flattened extremity, for the purpose of being armed, if occasion require, with a ligature, a skein of silk, or a piece of tape.

The porte-caustic should be of platinum, as this metal best resists the action of nitrate of silver, which is the caustic generally carried in the pocket-case. The platinum cup may be fitted to a stem of wood, or it may be so made as to be received into a silver case; the latter is the best arrangement. In addition to the lunar caustic, the surgeon will find it convenient, oftentimes, to have a crystal of the sulphate of copper in his case.

Fig. 3.



The double catheter is made of silver, as is the common male, or female, catheter. It consists of three pieces, as represented in the annexed drawing, (see fig. 3.) A, a straight tube, about five inches long, having at its upper extremity two rings firmly soldered to the tube at points opposite to each other; while the lower extremity has a female screw-thread cut upon it, of half an inch in length: B, a beak, an inch and a half or two inches long, slightly curved, its lower extremity closed and rounded, while the upper end is provided with a male screw,

corresponding with the female screw of the staff which is intended to receive it. Just above the lower extremity of this beak, two oval or rounded fenestræ are cut, one on each side, thus throwing open the cavity: C, another beak, about seven inches long, having a curve similar to that of the ordinary male catheter, and its upper and lower extremities adjusted as are those of the shorter beak. By simply screwing the short curved piece to the staff, we have an elegant female catheter; by similarly attaching the long curve, a male catheter. When in the pocket-case, the short beak should be kept screwed to the staff.

This instrument is very well made by Mr. Warner of this city, Commerce Street. The tube should be thicker and stronger than that of the ordinary catheter, and care should be used that the joints be accurately fitted.

The advantages of having so important an instrument as this reduced to a form so portable, need not be insisted upon.

In addition to the instruments above enumerated, the pocket-case may be made to include a spatula, a double canula with its wire, a seton-needle, and a razor. These, however, are not so essential elements of the case, as those before mentioned; generally they can be dispensed with, or other instruments may well be used in their stead; and their presence will render the pocket-case much more bulky and cumbersome.

The blades of the bistouries and scalpels may be so made as, when not in use, to be concealed within the handle, as the blades of the ordinary pocket-knife; by this arrangement, the edge of the instrument will be protected from injury.

CHAPTER II.

ON SURGICAL DRESSINGS.

THE various appliances used in surgical dressings may be thus enumerated: lint, cotton, tow, compresses of various kinds and forms, sponge-tent, setons, adhesive and other plasters, poultices, lotions, cerates, ointments, liniments, bandages, sponge, and apparatus of various kinds, more or less complex, for special purposes. Some description of each of these will be necessary.

1. LINT is the soft fleecy substance obtained by unravelling old linen. It may be procured in the shops in the form of what is called "patent lint," or it may be prepared as required for use, by scraping, with a sharp knife, the surface of old linen, previously put upon the stretch. The linen selected for its preparation should be soft, from use and washing. As thus obtained, the lint is very light and delicate, and admirably adapted to absorb the secretions of parts to which it may be applied. The "patent lint" is sold in sheets or rolls, one of its surfaces is fleecy, the other is smooth: its texture is compact, certainly not nearly so porous as the loose lint; hence it absorbs much less readily and freely than the latter. Both varieties of lint are applied dry, or covered with cerates, or saturated with some kind of lotion.

The French surgeons employ an admirable sort of lint, which they term "*charpie.*" It is now very generally used in this city, and, indeed, throughout the country, when it can be procured. It is thus made:—linen, of a coarse or fine texture, according to circumstances, is cut into small pieces, a few inches square, and its tissue completely unravelled, thread by thread. The coarser kind of charpie may be made of old table-cloths; the finer sort of a lighter material. Velpeau gives a decided preference to charpie made of old linen, as being much more absorbent, and much less irritating, than that made of the new fabric.

(Charpie of an excellent quality is made in this city by Mrs.

Jones, southwest corner of Walnut and Juniper streets, and is kept for sale in many of the apothecary shops.)

Lint, in its various forms, is used as a simple application to ulcerated or excoriated surfaces; to favour an equable and even pressure upon any part; to prevent adhesion between the walls of cavities, natural or accidental; to absorb various secretions, and as a vehicle by which medicinal applications may be made, when and wherever required.

Various arbitrary terms have been applied to no less arbitrary forms, which lint, and especially charpie, may be made to assume, as an element of surgical dressings. Thus, there is the plumasseau or pledget, the roll, the bullet, the mesh, the tent, the tampon, the pellet, &c.

The PLUMASSEAU is prepared by simply folding, at the middle, a sufficient number of the filaments of charpie, previously laid parallel to each other. For the sake of neatness, the ends of the threads may be cut off evenly, or inverted, and the mass thus formed moulded by the hands to any shape, flat, round, circular, square, or oblong, to adapt it to particular parts.

The ROLL is a mass of charpie, rendered cylindrical by the hands, and firmly tied at the middle. It is chiefly used to arrest hemorrhage, by pressure, from a deep-seated vessel, or to absorb the secretions from wounds or cavities. For convenience in withdrawing the mass, the string, tied about the middle, may be left attached at this point, and projecting from the orifice.

The term BULLET is applied to a small mass of charpie or common lint, rolled into the form of a small ball. A number of these may be advantageously used for the same purposes as the roll just described.

The MESH resembles the roll very much in its uses; its fibres are left loosely floating, instead of being rolled together. It is sometimes employed in the treatment of sinuses and fistulous canals, by being thrust to the bottom of such cavities, on the end of a probe, with the view of preventing their healing at the orifice. It may be introduced dry, or covered with some lotion or cerate, more or less stimulating.

The TENT of charpie is made by twisting a certain amount of this substance into the form of a cone. For the purposes

for which a tent is generally required, it is very much inferior to the sponge-tent.

The TAMPON is merely a large ball of charpie, or it may be a number of bullets. It is used in the plugging of bleeding wounds, &c.

The PELLET consists of a ball of charpie or common lint, enclosed in a piece of soft linen, firmly tied. It may be used as a tampon.

The good sense of the surgeon or dresser will enable him to employ these different forms of lint seasonably, or to invent others still better.

2. COTTON may be used with advantage in many cases. Its cheapness—and the almost universality of its diffusion—are of themselves great recommendations, in connexion with its softness, lightness, and the porosity of its texture. It is sold either as "carded cotton," or, in the form of "sheet cotton," in large sheets, of which both surfaces are smooth, more or less glazed, forming, as it were, thin pellicles, between which the true cottony mass is inclosed. As an application to secreting surfaces, it will be found to be less absorbent than lint, and probably more irritating. It is very much employed as a covering to extensive superficial burns, to protect their sensitive surface from the action of the air and other irritants. But when there is much suppuration or other discharge, the cotton, becoming more or less imbued with the secretion, is heavy and heating, and is readily displaced by slight movements of the patient, becoming rolled into hard masses. Probably every dresser has been often much annoyed, by the difficulty which he has experienced in removing from a large moist sore, these numerous indurated pellets of cotton, which sometimes adhere very tenaciously to the granulations. Its chief uses—and for these it is almost invaluable—are, to form a soft bed in which an injured part may be reposed, to prevent unpleasant pressure and excoriation from bandages and other apparatus, and to envelope parts, of which the natural temperature has become depressed.

3. Tow is never applied directly to a secreting or abraded surface; being too harsh and irritating. It is made use of in enveloping other dressings in cases of profuse discharges, as in compound fractures, suppurating stumps, &c.

4. The COMPRESS is employed for a variety of purposes.

As the name imports, it was at first used to effect, or to facilitate, pressure upon any part; now, however, it has acquired a wider application, being equally adapted to the covering and protection of injured surfaces; to retain other dressings, and to give regularity and symmetry to the form of a limb, or of any other part, to which a bandage is to be applied.

Compresses may be made of various materials, as linen, muslin, woollen fabrics, lint, cotton, tow, &c. When intended for direct application to secreting surfaces, they should be of lint or soft linen, and applied dry or anointed. The advantages of a flannel compress are, its elasticity, its warmth, and the readiness with which it imbibes any moisture of the surface. The cheapness of the different fabrics of cotton recommends them for many purposes; for wherever economy may be properly consulted, without conflicting with more important considerations, the surgeon, whether in hospital or in private practice, should not fail to be influenced by it in the choice of the material for his dressings. Whenever a compress is to be employed external to other dressings, or upon an uninjured surface, it may, as a general rule, be formed of cotton stuffs, as properly as of linen.

For convenience, accuracy, and neatness of application, compresses are made of divers forms and shapes, to suit particular cases and indications; Velpeau's division is a very simple one, into the plain, the divided, and the folded. The most important are, the square, the graduated, the perforated, and the split compresses.

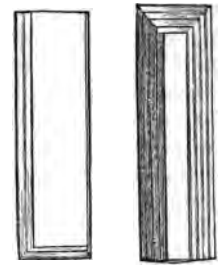
The square compress is sufficiently well described by its name, as are also the oblong and the triangular compresses; their size and thickness may vary at the pleasure of the surgeon, and with the requirements of each case.

The graduated compresses are so contrived as that they shall present a gradually diminishing surface at the summit, as their thickness increases.

The common graduated compress may be made by taking a strip of any material of the required width, and folding it upon itself so that each successive fold shall be shorter than the one which preceded it. By thus regulating the length of the folds at one end only, the single graduated compress is made (fig. 4); by pursuing the same plan at both extremities, the double graduated compress. The pyramidal compress is

formed by piling successively on each other pieces of any material, of gradually and regularly diminishing size,—of square, oblong, or circular shape (fig. 5).

Fig. 4. Fig. 5.



These varieties of the compress are useful when firm pressure, made generally with the aid of a bandage, or of the hand, is required upon some deep-seated point, as, for example, to arrest the circulation through a bleeding vessel.

The perforated compress, as its name indicates, is one in which an aperture has been cut. The number of such apertures may vary indefinitely. A very elegant dressing to a suppurating surface consists of a compress, or a simple piece of linen, perforated in a cribriform manner, and spread with cerate of some kind. The pus has in this way free escape, and may be absorbed by lint laid upon this sieve-like covering.

The chief varieties of the split compress, are the retractor of two and of three tails, and the Malta cross.

The retractors are formed by making one or two longitudinal slits (as two or three tails are required) in a piece of muslin three or four inches wide, and two and a half feet long. They are used in amputations to draw up the soft parts, after the incision has been made, for the purpose of protecting them from the saw, while the bone is being removed as high up as the incision of the soft parts will allow. The retractor of two tails is employed in amputations of the arm and thigh; the other in the removal of the forearm and leg. In its application, the former is made to grasp the bone between its tails, which are then drawn upwards beneath the member, the body of the retractor being carried in the same direction along its superior face; the soft parts are thus enclosed and shielded between the two. • In using the retractor of three tails, the middle tail is thrust between the two bones of the leg, or forearm.

To prepare the Malta cross, (fig. 6), take a square piece of linen or patent lint, of the required size, and fold it through the middle of one of its sides; double the oblong thus formed upon itself through the centre of one of its longitudinal dia-

meters, and from the free angle of the smaller square thus produced, (the angle at which the various laminæ composing the square are separable), make an incision along its oblique diameter, to within a short distance of the opposite angle. When the square is re-opened, it will present the form of the Malta cross. It is used as a direct application to stumps, having been previously perforated at numerous points, and spread with cerate.

Fig. 6.



The half Malta cross is made by folding an oblong piece of linen, or patent lint, through the middle of its longitudinal diameter, and continuing an incision from one of its free angles, along the oblique diameter, nearly to the opposite angle. Its uses are as those of the last described.

5. Sponge-tent is prepared by thoroughly saturating soft sponge with melted beeswax, or gum tragacanth, and subjecting it to pressure as it cools. It is employed for the purpose of dilating wounds, fistulous canals, &c., which it effects by imbibing moisture from the cavity, and thereby swelling. For use, a piece of the hardened mass of sponge is cut of the requisite size and form, and gently introduced into the cavity, where it may be easily confined by a piece of adhesive plaster stretched across the orifice.

It is well to recollect that the prolonged retention of a sponge-tent, particularly in irritable patients, frequently excites violent pain, swelling, and heat in the part, accompanied often with considerable fever. In such cases, these effects speedily disappear upon the removal of the tent, followed or not by the application of some soothing dressing, as warm water, or a poultice.

6. Setons are made of a variety of materials: as of a skein of silk, a piece of linen tape, or a piece of ordinary soft linen, which has been unravelled along its borders.

7. Adhesive plaster, is composed of some substance or substances, possessed of tenacious or adhesive properties, and susceptible of being spread upon linen, muslin, or some similar material.

The "emplastrum resinæ," of the U. S. Pharmacopœia, is

the one generally employed in this country. It is sold in the shops already spread upon linen or muslin. (The adhesive plaster made by Charles Ellis, of this city, is particularly excellent.)

Adhesive plaster is one of the most indispensable articles of dressing to the surgeon. Its uses are numerous.

Its most frequent employment is in the approximation of the lips of wounds. For this purpose, the plaster should be cut into strips, varying in width according to circumstances, but, for neatness-sake, the strips intended for the same dressing should be of equal width. In cutting them, the sheet of plaster should be made tense by the hands of the surgeon and an assistant, while the former forces a pair of sharp scissors, without closing the blades, across the sheet parallel with the course of its threads; in this way the strips may be cut straight and very rapidly.

For application, the strip should be warmed, by being held near a fire; or, which is much better, by wrapping its unspread surface around a vessel containing boiling water; the wound having been carefully cleansed, and the surrounding surface washed and dried, and freed from hair, one extremity of the strip is placed upon the skin at a suitable distance from the edge of the wound,—the distance varying according to the degree of force which shall be requisite to retain the edges in contact,—the edges themselves are accurately approximated by the fingers of the dresser, and the strip is drawn across them, and pressed all along its course upon the skin.

If the wound is so long as to require the application of two or more strips, spaces should be left between them, to permit the escape of fluid.

The length of time during which the plaster should remain must vary in different cases. Generally, the strips should not be disturbed until the wound has cicatrized, or until its edges are somewhat firmly agglutinated, unless they shall have become previously loosened from accidental causes, or productive of some unpleasant effect.

In removing the dressing, the portions of the strip on each side of the wound should be raised alternately, and fresh pieces applied as soon as possible, if the same dressing is to be continued. Where a wound is traversed by more than

one strip, a fresh one should take the place of each, as it is removed, before a second is withdrawn. This precaution is necessary, in order that the delicate adhesions of the lips of the wound shall not be destroyed or weakened.

Many years ago, Mr. Baynton, an English surgeon, recommended the employment of adhesive plaster in the treatment of ulcers. The plaster which he used was composed of six drachms of resin melted with a pound of lead plaster. He directed that the ulcer be first carefully cleansed, and the surrounding surface denuded of hair; that adhesive strips, two inches wide, and of sufficient length to encompass the limb, and, in addition, to extend four or five inches over the edges of the ulcer, be passed around the leg, from an inch below to two or three inches above the sore, and with sufficient force to approximate slightly its edges,—each successive strip being in contact with that last applied; that compresses of soft calico be placed around the limb, and the whole enveloped with a bandage from the toes to the knee. If there should be much heat or pain in the limb, cold water may be applied over the dressing. This treatment is best adapted to chronic indolent ulcers, attended with swelling and induration of the limb. As the tumefaction abates, the dressings are to be applied more tightly: they should be changed more or less frequently, according to the greater or less amount of suppuration, from twice in twenty-four hours, to once every three or four days. According to the experiments of Velpeau, Boyer, Roux, and others, ulcers are cured more speedily by this method of treatment than by any other; walking about on the limb, moderately, facilitates the cure. Boyer found that the average length of treatment by this mode, calculated from a large number of cases, was twenty-six days; while, according to Duchatelet, of 690 cases treated by the ordinary methods, the average duration of treatment was fifty-two and a half days. (Cutler, pp. 210, 211.)

The ordinary adhesive plaster of the shops will very well answer the purpose of that employed by Baynton. Previous to its application, the limb, from the toes to within a few inches of the ulcer, should be enveloped by a roller, which is to be continued over the whole leg after the other dressings have been applied.

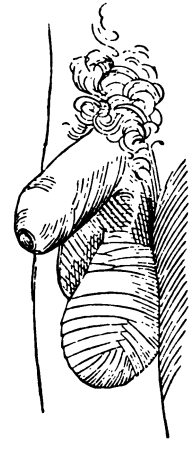
In the drawing, fig. 40, this method of treatment is illus-

trated, the upper part of the ulcer being purposely left exposed.

The same plan of treatment has been extended, by Velpeau, Boyer, and Roux, to all ulcers which have become atonic or chronic, and by the former of these distinguished surgeons, particularly, to burns (Velpeau, Méd. Opérat., vol. i., p. 257), and also to varicose and ganglionary tumours, &c., &c.

M. Fricke, of Hamburgh, first called attention to the efficacy of compression, methodically and carefully made by strips of adhesive plaster, in the treatment of epididymitis. They may be thus applied: the scrotum should be carefully cleansed, and the hair shaved from it; the testicle is then forced to the bottom of the sac, and the affected side of the scrotum, clasped just below the ring by the thumb and forefinger of the left hand, is surrounded by a very narrow strip of plaster, which is then carried down over the scrotum in such a way as to apply itself neatly and smoothly to the skin; successive strips are used, until the part is entirely enveloped. The pressure should be moderate and regular. As the swelling subsides, the strips will of course become loose, when they may be removed, and fresh ones applied as before. If there be much pain, the employment of the adhesive plaster may be preceded by the application of leeches over the scrotum itself, or in the groin.

Fig. 7.



Chronic indurations generally of the testicle are very often removed or diminished by this treatment. The annexed drawing illustrates this application (fig. 7).

It will frequently be found that, after the removal of adhesive strips from the surface of the body, a portion of the adhesive matter remains upon the skin; water alone will not easily remove it, but gentle rubbing with a sponge moistened with spirit of turpentine, will readily cleanse the part. The black discoloration often noticed is a matter of no consequence; it is simply owing

to the action of the matter of the secretions of the surface upon the lead plaster.

Several objections have been urged against the employment of the common adhesive plaster; some of them are well founded, others not so. It sometimes, though by no means usually, irritates the skin, producing an erythematous inflammation, and occasionally a papular or a vesicular eruption; this is particularly the case when the application is made to the skin of young children and infants. To avoid such inconveniences, the "isinglass plaster" has been recommended as a substitute for the other. It is prepared by spreading upon oiled silk, or silk glazed on one side only, and on the unglazed side, a solution of Isinglass in Spirit (Liston). When dry, the silk may be laid aside until required for use, then it is cut into strips of the desired width, and its adhesive surface softened by the application to it of a hot moist sponge; the strips are to be employed as directed for the ordinary adhesive plaster. The advantages of this preparation are, its cleanliness, its perfectly unirritating nature, and its transparency, whereby the surgeon is enabled to see the condition of the surface upon which it is applied, without removing the strips. It is, however, less adhesive than the common plaster; for, as has been well observed by Dr. Smith ("Minor Surgery," p. 38), the warm discharges from the part to which the isinglass plaster is applied, soften its material, as did the hot moist sponge. Therefore, whenever considerable tenacity of adhesion is requisite, the ordinary plaster is preferable.

(The isinglass plaster is made in this city by Mr. Husband, Apothecary, Spruce Street.)

"COLLODION," an ethereal solution of gun-cotton, will be found to be a very convenient adhesive material. To apply it, lay strips of muslin or linen across the wound, the edges of the latter having been accurately approximated, and saturate them with the collodion by the aid of a camel's-hair pencil. The strips should be made of some *unglazed* fabric, as this imbibes the solution more readily and thoroughly than the glazed.

In slight wounds the strips may even be dispensed with, the liquid being merely painted over the surface, the edges of the wound being held together until the collodion is dry.

The contractility of this substance is such that it has been recommended as a means of curing small *nævi*, by the compression which it induces in drying.

Various other plasters are frequently employed by the surgeon.

The soap plaster—"Emplast. Saponis,"—spread upon soft sheepskin, and then cut into strips, or into pieces of any shape and size, will be found oftentimes to answer a very admirable purpose, in making pressure upon an enlarged joint, or an indolent tumour, &c., &c. It is very mild and unirritating, and preserves the integuments soft and moist, and is an excellent preventive of excoriation.

The mercurial plaster is very commonly employed as a resolvent of tumours, and other indurations. The belladonna plaster is an excellent anodyne application.

Plasters should be smoothly and evenly spread on coarse muslin, or stiff brown paper, or, which is much the best material, on soft sheepskin. A piece of skin, or other material, should be cut of a shape suitable for application to each particular part, and rather larger than the surface intended to be covered by the plaster; a narrow strip of paper may be then pasted around its margin, and within the space thus bounded, the plaster is to be spread, after which the paper may be removed. In order that it may adapt itself smoothly, accurately, and neatly to the surface, it is well to make several slits from the margin of the plaster towards its centre.

8. One of the most common articles of dressing, both in domestic and professional practice, is the POULTICE. When badly made, it is undoubtedly deserving of the abomination, with which it is so amusingly and feelingly regarded by Mr. Liston; but when properly prepared, and correctly used, it cannot, we think, be conveniently dispensed with for any other substitute whatever.

The poultice should be always soft and moist, and these requirements should be kept in view, as far as possible, in the choice of the materials of which it is to be made. The substance which is to form its basis is generally in the form of a powder; this should be stirred about with sufficient water to give to the mass a soft consistence, yet not so moist as to permit the fluid to flow from it. The water may be cold or hot, according to circumstances, and may be best incorpo-

rated with the powder by adding small portions of each alternately and successively. The semi-solid mass thus prepared may be spread upon a piece of muslin smoothly and evenly, by the aid of a wooden or iron spatula, or an ordinary table-knife; it should be from a fourth to half an inch thick, and occupy just so much of the surface of the muslin as that the margin of the latter may be reflected upon it, all around, for the space of half an inch; this latter arrangement gives to the poultice a very neat and elegant appearance, and facilitates very much its removal from the surface to which it may have been applied.

Some surgeons prefer to protect the part from immediate contact with the poultice, by the intervention of a piece of fine cambric or gauze, previously laid upon the surface of the latter. For so doing, they urge that, otherwise, portions of the poultice remain adherent to the skin or ulcer, after the mass has been removed, and are displaced with some difficulty and occasional pain to the patient. If, however, the poultice has been properly prepared and applied, and not too long retained, this annoyance will rarely occur. Moreover, by thus covering the poultice, we are deprived, in a great measure, of the benefit derivable from the direct contact of its materials with the affected part; and this consideration is an important one oftentimes, as, for example, when the poultice is medicated; for, as Velpeau remarks, "poultices are not intended to act merely as compresses saturated with warm water." Yet when the application is intended for the eye, or the neighbourhood of the nostrils or mouth, or when it contains ingredients which may be too irritating for the sound skin, it is very proper to use the precaution alluded to.

Generally, the smearing of the poultice with oil, or grease of any kind, is unnecessary and objectionable.

In order to retain the warmth and moisture and softness of the poultice as long and as completely as possible, it should always be covered externally with a piece of oiled silk, or thin India-rubber cloth; the unpleasant odour of the latter, however, renders the first a preferable application.

This dressing should be changed at least twice daily; and when the discharge is profuse, in warm seasons, when the poultice is very soon soured—or when the speedy production of suppuration, or the relief of great pain is desired, the ap-

plications should be renewed as often as every two or three hours, or even still more frequently.

In removing it, the poultice should be gently drawn up by one side, and reflected upon itself gradually, until the whole is lifted up; if it adhere at any point, its detachment will be easily effected by allowing a little warm water to trickle over the part; before applying a fresh dressing, the surface should be carefully and gently cleansed.

To retain the application in its place, a roller may be passed around it, extending a short space both above and below it. But it often occurs that the part to which the poultice is applied, whether it be an irritable ulcer or otherwise, is too tender and painful to bear the agitation to which it must be subjected in the use of the roller; in such cases the "bandage of Scultetus" should be employed; thus, the entire dressing may be renewed without moving the suffering part.

FIG. 8.

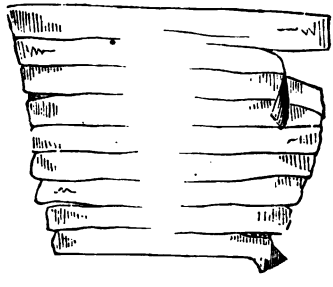


FIG. 9.



Dr. Hays, of this city, is in the habit of making use of a bandage, in similar cases, which may be considered as a modification of the many-tailed bandage; its simplicity and perfect adaptation to this and numerous other analogous purposes, renders it worthy of description.

A piece of muslin more than wide enough to envelope the part, as the leg, for instance, and rather

longer than the poultice, or other application which it is intended to retain, is cut or torn, transversely from each margin, leaving a central space entire, of some few inches in breadth; this is laid on the pillow or bed, and the leg, with the poultice applied, is placed upon it; then, commencing from below, the tails, first on one side and then on the other, are alternately and successively brought over, as the strips of the bandage of Scultetus, and the last two tied in a single or double bow-knot. This simple bandage will be found very useful in retaining blisters, cerates, or any similar application, upon parts too sensitive to admit of much disturbance: figs. 8, 9, exhibit this bandage, free, and applied.

If the discharge is at all profuse, it should be absorbed as soon as possible by cotton, tow, or some similar substance, arranged to receive it. Thus if the arm be the part affected, it should be laid upon a pillow (the patient being in bed), protected by a piece of oil-cloth, upon which some tow or bran has been placed; the same disposition may be made with the leg; or this member may be conveniently put in a fracture-box filled with bran, or containing a pillow protected as before. In order to preserve the bed-clothes from contact with the discharged matter, a semi-circular framework of wire or bamboo, should be thrown over the limb. (See fig. 10.)

The material of which the poultice shall consist must vary with the indications to be fulfilled in each case. It may be emollient, refrigerant, astringent, stimulating, or anodyne.

The emollient poultice, as its name implies, is made of perfectly bland and unirritating material. The materials of which it is usually prepared, are bread and milk, bread and water, and water with corn-meal, flaxseed meal, or slippery elm powder. Each surgeon, probably, has some fancy of his own with regard to what forms the best poultice, some preferring this, some that material. Abernethy, who seems profoundly to have studied the philosophy of poultices, gives decided preference to the bread and water, and the flaxseed meal poultices; after detailing the mode in which the latter should be prepared, he exclaims, rapturously: "When thus made, oh! it is beautifully smooth; it is delightfully soft; it is warm and comfortable to the feelings of the patient." (South's "Hints on Emergencies," p. 12.)

The bread poultices, made either with milk or water, be-

come dry and stiff sooner than those prepared with flaxseed meal; the latter contains a considerable portion of oil, which imparts great softness to the mass when wet; but it also gives it a not very pleasant odour, and in warm weather, or when long in contact with an inflamed surface, it soon becomes rancid and irritating; upon some skins, moreover, it produces a vesicular eruption. Perhaps the poultice least liable to objection, is that made of the powder of slippery elm bark.

The above-named poultices when applied cold may be termed *refrigerant.* An application of this kind may be prepared by employing a solution of acetate of lead, in the proportion of ʒij. or ʒiij. to a pint of water, instead of simple water, in mixing the poultice. In order to increase their cooling effect, they may be applied without covering them with oiled silk or any bandage, so that evaporation shall be unchecked. It must be recollected, however, that although cold when first laid upon the part, they soon acquire the same temperature as the surface; they require, therefore, frequent renewal.

Astringent poultices may be made by incorporating any powder of astringent property, with some one of the materials already mentioned. The substances most frequently used are powdered oak bark, galls, and alum. A very elegant poultice of this kind is prepared by rubbing up alum with the white of egg.

Stimulating poultices are formed in the same way, by incorporating stimulating substances with some sort of meal, and water. With this view the scrapings of carrot, or horseradish, are employed. Solutions of chloride of lime, or of soda, of creasote, or of common soap, are often used; or a poultice may be made of stewed onions. One of the best and most agreeable of the stimulating poultices is the camphor poultice, made by incorporating spirits of camphor with the meal or other substance used as the basis. It is particularly serviceable as an application to gangrenous parts, sloughing ulcers, &c.

The fermenting poultice is made by incorporating yeast, or porter, with corn meal, and is of great advantage in hastening the separation of gangrenous parts. A very common preparation of this sort is the ordinary mustard poultice. These

applications are employed when a decided irritant or stimulating effect is indicated.

An anodyne poultice may be made by stewing bruised poppy-heads until they become somewhat soft and adhesive; or the dregs of opium, left after the preparation of laudanum, or this liquid itself, may be mixed with meal; or the bruised leaves of belladonna may be moistened, and applied. The leaves of the tobacco plant moistened, may be used in the same way, but their application should be carefully watched, lest too great prostration ensue. Hops, or chamomile-flowers, enclosed in a flannel bag wrung out of hot water, or incorporated with meal or bran and hot water, form an excellent anodyne poultice.

Medicated poultices may be very elegantly prepared, by making an infusion of the substance, whatever it be, which has been selected as a medicament. Poppy-heads, the carrot, potato, horseradish, various astringent substances, may be simmered for an hour or two in a closed vessel containing water, and the liquor, after having been strained, incorporated with meal of some kind. (South, p. 11.)

Mr. Liston, and some others, object altogether to the use of poultices, proposing to substitute water, medicated or simple, cold or warm. For this purpose, some one of the infusions above mentioned will answer very well. They should be applied by means of linen, lint, or flannel, several times folded, and saturated with them, thus constituting fomentations; they should be kept constantly upon the part. To be of real benefit, their employment demands assiduous and unintermitting care from the attendants, much more, indeed, than can be generally expected or obtained, particularly in hospitals; this constitutes a serious objection to their being generally used as substitutes for poultices. Neither do they supply the same body of heat as the latter, when heat is required. They are, however, more cleanly than the poultice, and this seems to be their chief advantage—an important one truly. Where a cold application of this sort is desired to reduce the temperature of a part, the most effectual is pounded ice, with which a bladder, or a bag of India-rubber cloth, may be partially filled: the temperature of the application will remain as low as 32° F., so long as any particle of ice remains unmelted, after which the water in the sac will

gradually acquire the temperature of the part to which it is applied; hence the bag must be examined from time to time, and the ice renewed when necessary. Sacks, intended expressly to hold water, are made of thin India-rubber cloth; one of these may be partially filled with water containing various saline substances which, during their solution, abstract its heat; this forms a very good substitute for the bladder of ice, when ice cannot be obtained. One ounce of nitre, one ounce of sal ammoniac (chloride of ammonium), and half a pint of water, may be thus employed. (Thomson, "Management of the Sick Room," p. 277.)

These applications, whether used in the form of poultice or of fomentation, fulfil a variety of indications. When employed warm, they relieve spasmodic pain, or sometimes continued pain; produce or promote suppuration; allay irritation frequently, and sometimes inflammation: diminish œdematous enlargements, by promoting local perspiration, or transpiration; induce resolution of acute or chronic inflammations and indurations, &c., &c. When cold, they are more directly sedative, and are generally used to subdue inflammation, or to overcome muscular action, or the tonic rigidity of tissues, as in the reduction of hernia. It must, however, be borne in mind, that the effects of these applications vary much in different individuals; thus in some, a warm poultice or fomentation, will resolve a phlegmon which presents, as nearly as can be judged, the same condition as one which, in other individuals, is most relieved by cold. The feelings of the particular patient should be consulted, to enable the surgeon to determine when one mode of treatment should be substituted for, or even be used instead of, the other.

In enumerating the circumstances to which these dressings are particularly applicable, it is hardly necessary to remark that the substances with which they may be medicated will modify accordingly their general action.

Within the last two or three years, an article of English manufacture, called "*Spongio-Piline*," has been introduced to the notice of the Profession, and recommended by the surgical staffs of several of the London Hospitals. It is also used to a considerable extent in the Massachusetts General Hospital, in Boston, and perhaps elsewhere in our own country.

It is in sheets, three-fourths of an inch to an inch in thickness, looking very much like a smoothly-cut slice of sponge, one surface being covered with a sort of glazing of India-rubber.

It imbibes water very freely, and the glazed surface prevents evaporation, as a piece of oiled-silk when laid upon a poultice. When wet it is not too heavy to be comfortable. The advantages claimed for it are its durability, its capability of being washed, and thus answering for different patients; and its cheapness, as compared with the cost of the materials of which poultices are made, or of those used in the preparation of fomentations; it being remembered that the same piece of Spongio-Piline will last, as it is said, a very considerable time, and be serviceable to a number of patients. This last claimed advantage is, we think, of questionable reality; for there would certainly be, to say the least, great probability that by thus preserving a piece of dressing as a sort of heir-loom, various inconveniences and dangers would arise from the transference from person to person of irritating, offensive, or inoculable matters. To furnish a piece of fresh "Spongio-Piline" to each hospital-patient who required an emollient application, would be a very expensive charity. Having, by way of experiment, applied a piece of this article, saturated with warm water, to our own person, we confess that the effect was less agreeable than that produced by a well-made poultice or a fomentation.

9. LOTIONS are composed of water variously medicated. They are usually applied upon some soft porous material, as lint or folded linen; they may be used tepid or cold; in the choice of temperature, the feelings of the patient may be very properly appealed to by the surgeon. If a refrigerant effect is desired from the wash, it should be applied upon a single fold of lint, or linen, and left exposed, or but slightly protected, so that evaporation may not be interfered with; where such an action is not called for, several folds of the porous substance should be laid upon the part and covered by a piece of thin oiled-silk—the whole to be retained in the manner alluded to with regard to the poultice.

As a general rule, lotions should be employed preferably to cerates, as being more cleanly, and not liable to become

irritating from high temperature of the part, or season of the year.

Formulæ for several lotions will be found at the end of the volume, with the uses of each.

10. "CERATES are unctuous substances, consisting of oil or lard perfectly fresh and sweet, united with wax, spermaceti, or resin, to which various medicaments are frequently added. Their consistence, which is intermediate between that of ointments and of plasters, is such that they may be spread at ordinary temperatures upon linen or leather, by means of a spatula, and do not melt or run when applied to the skin." (U. S. Dispensat.) They are used as applications to abraded or ulcerated surfaces, and their composition is varied for adaptation to each case.

11. "OINTMENTS are fatty substances, of the consistence of butter, such that they may be readily applied to the skin by inunction." (U. S. Disp.) They are simple, or composed of various medicaments. The ointments, as well as the cerates, are easily affected by a high temperature, becoming rancid and unfit for use. They are usually applied upon the sound skin.

A number of ointments and cerates, such as have been found useful, are given at the end of the book, with their particular applications.

12. LINIMENTS are intended for application to the unbroken surface, by friction with the hand, or soft flannel. Oil should constitute the basis of the liniment, and with it may be conjoined a variety of modifying ingredients, so that it may be rendered soothing, or irritating, as required.

The reader will find formulæ for the preparation of many very serviceable liniments, at the latter end of the volume.

13. The SPONGE, though it is not chiefly used as an article of dressing in surgery, is of such essential importance to the surgeon, that a few words concerning it will be proper.

The common sponge, as found in the shops, is too full of gritty particles to be fit for surgical purposes. It may be sufficiently well prepared for ordinary uses, such as the cleansing of uninjured surfaces, by maceration in boiling water, and subsequent beating, until the sabulous or calcareous particles are generally removed. But for nice purposes, as the washing of inflamed or ulcerated surfaces, still farther

preparation is requisite; after having been treated as above, it should be macerated in water acidulated with about one-thirtieth of its bulk of chlorohydric acid; dried and beaten again, and then bleached by exposure, when moist, to the vapour of chlorine, or some other decolorizing agent. It is now soft and clean.

Bandages and the variety of apparatus employed in the treatment of surgical diseases and injuries, will be considered hereafter.

CHAPTER III.

GENERAL RULES FOR DRESSING.

If a surgeon is called upon to attend to an injury just occurred, he should take a rapid, yet careful, observation of the patient, in order to ascertain the condition of his strength and mental functions, and to discover if there be any circumstances calling for prompt attention previous to the systematic application of a dressing. Thus, if there be much prostration present from any cause, fresh air and cold water should be freely employed to revive the patient; or a little wine and water, with or without laudanum, should be administered; and all obstacles to free respiration, such as a cravat, a tight vest, pressure around the abdomen from tight pantaloons, should be at once removed. If there be an external wound, it should be immediately examined, and prompt measures taken to arrest hemorrhage, if any exist.

As soon as these preliminaries have been attended to, the surgeon may proceed to the regular application of the dressing, as in an ordinary case where no such emergencies present themselves.

Having first arranged such articles of dressing as are likely to be needed in the case under consideration, and conveniently disposed of the necessary instruments, (all useless display being avoided, as being not only uncalled for, but positively annoying to the patient,)—and having at command sponges and towels, and one or two basins of warm water, the surgeon should expose the diseased or injured part. In doing this, great care and the utmost gentleness should be observed; if the patient be dressed, and the affected part, as, for example, the arm or leg, be very sensitive and painful, the clothes should be removed by ripping them along a seam, rather than be drawn off in the usual manner; and any application which may have already been made must be withdrawn with the same care, so as not to inflict any unnecessary suffering.

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The affected part and the surrounding surface should now be cleansed as perfectly as can be effected, without too much pain, by means of a sponge and castile-soap and water; in addition, if there be a wound, or if it be deemed advisable to apply adhesive plaster, the surface should be denuded of hair, either by using a razor, or, which will answer equally well, a sharp scalpel.

If there be hemorrhage to any notable amount, it should be arrested at once, by means of ligature or the application of cold, or some styptic; or if it be very slight, a momentary exposure to the air may control it; or, finally, the surgeon may trust for its arrest to the pressure of the dressing which he is about to apply.

In the choice of the latter, the surgeon will, of course, consider the indication to be fulfilled in each particular case as of paramount importance; but it should also be borne in mind that, lightness, freedom from any undue heating qualities, and cleanliness, are also essential to the perfection of a dressing. The retaining bandage should be such as may be applied and removed with as little difficulty and annoyance to the patient as is consistent with its special object, and all unnecessary pressure and envelopement are to be deprecated.

After the dressing has thus been completed, the patient, or the particular part involved, must be placed in such a position as will most conduce to his comfort and security. Generally, a dependent position is to be avoided; to prevent it, pillows may be placed beneath the limb, if the leg be involved, or, if it be the arm, a sling may be used to support it.

Fig. 10.



The surface may be protected, when necessary, from the pressure of the bedclothes, by placing over it an arch made of two semi-circles of hoop crossed upon each other, or of wires, or bamboo, fixed in a frame (fig. 10).

The dressing should be disturbed as little and as seldom as is consistent with the successful treatment of the case; all unnecessary renewals should be avoided. Generally, a dressing should not be renewed, or removed, so long as the first remains in

place, is clean, free from unpleasant smell, and is comfortably borne, and so long as no new and untoward symptom has occurred.

All soiled dressings of every kind, the sponges, basins, and, in short, every thing which mars the cleanly appearance of the sick-room, or vitiates its atmosphere, should be removed as quickly as possible, and the bedding and clothing of the patient be kept clean and well arranged.

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CHAPTER IV.

ON THE USE OF WATER.

THE various modes in which water is made use of as a medicinal agent, by the surgeon in his daily duties, constitute a very important subject for study; and one to which a few pages may profitably be devoted in a treatise on Minor Surgery. A brief consideration, therefore, will be here entered into of *Irrigation;* the *Douche;* the *Water* and the *Vapour Baths*, and finally the subject of *Fumigations* will be noticed. The best modes of insuring purity of the atmosphere of a sick-room, or of a hospital ward, will also be briefly alluded to.

SECTION I.

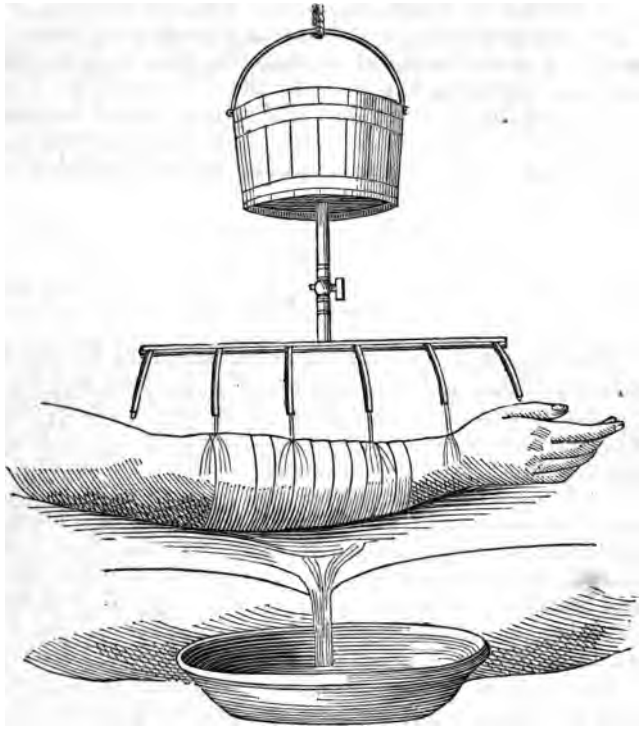
IRRIGATION.

The surgeon has a very admirable substitute for the refrigerant poultice in *Irrigation*, whereby the part may be kept constantly bathed in cold water of an uniform temperature. The water may be simple, or medicated by any of the substances before enumerated, or others similar. The same plan might be used to insure a hot or warm fomentation, if the fluid could be maintained at one and the same temperature, but this would be attended with so much difficulty, that it would scarcely be prudent to attempt it; since the alternate chilling and heating, to which the part would be exposed, from successive changes in the thermometrical condition of the water, would be productive of serious inconveniences and dangers.

The simplest method of effecting irrigation is, to cover the part with folds of soft linen, or lint, previously moistened, and to conduct a constant current of water to it through strips of linen, or cotton wick, from a reservoir, as, for example, a basin placed at some convenient point. In order that the clothes of the patient, or his bedding, be not wetted, the part,—as a

limb,—should be laid upon a pillow protected by a piece of oil-cloth so arranged as to form a sort of gutter, or funnel, along which the water may pass and fall into another reservoir placed beneath it. M. Velpeau employs an apparatus, to fulfil the same purpose, which possesses this advantage, viz., that by it the amount of water and the force of the stream can be accurately regulated at pleasure, by turning a stop-cock. The annexed figure, (fig. 11,) taken from M. Velpeau's work,

Fig. 11.



(Méd. Opérat. i. 265,) sufficiently explains the apparatus which he uses.

The very great benefits derivable from the free and constant use of cold water in various surgical as well as medical dis-

eases, have been known for ages; from time to time, however, it has been neglected, and again invoked: it is now, once more, resorted to, in the manner just described. It is particularly applicable to the early treatment of severe contused and lacerated wounds; sprains; simple contusions; dislocations, accompanied by much pain after reduction, and many other painful injuries and diseases of the joints; phlegmonous inflammation; some varieties of painful ulcers, &c., &c. (MM. Velpeau, Berard, Malgaigne, South's Ed. Chelius, &c., &c.) The feelings of the patient should be consulted, in determining the propriety of continuing or relinquishing this plan of treatment. It should be discontinued, or at least suspended, if it increase the pain which it was intended to relieve, or induce sensations of chilliness and discomfort.

SECTION II.

THE DOUCHE.

Another, and a very beneficial mode in which water, either warm or cold, may be applied to the surface of the body is, by *the douche*, which consists of a column of water varying in volume, made to fall upon the body from a greater or less elevation. Two series of phenomena attend the action of the douche: the immediate effect, or the shock, and that which follows it, or the reaction. The intensity of these vary according to the temperature of the water, its volume, and the height from which it falls; so that by regulating these circumstances, the peculiar effect to be derived from the douche, in each case, may be obtained. The primary, or direct result of the cold douche is sedative; but, in ordinary cases, the nervous system more than recovers from its temporary depression, and an excitement ensues. This depression may be prolonged, and the period of excitement postponed, by gradually increasing the mass of water which falls upon the surface, or the force with which it descends, or the height of the column, or finally, by gradually lowering its temperature; and by combining all these modifications, a still greater effect will ensue. These circumstances should be attended to, therefore, where a sedative influence is re-

quired. So soon as a certain amount of depression occurs, the action of the douche may be suspended, and again resumed when reaction commences, as indicated by the return of the previous temperature, colour, and fulness of the part. This alternate action and suspension of the agent may be continued so long as may be indicated. After the douche, the surface should be gently dried by the application of a soft towel, so as not to excite a glow. After successive and repeated employment of the remedy, as above recommended, it will generally be found that reaction does not occur, or that it is very moderate and within bounds.

The warm douche is productive of less depression, and the reaction is proportionally less in degree, than when the cold is resorted to. Generally, the warmer the water, other circumstances being equal, the less the effects, both primary and secondary.

To constitute the cold douche, the temperature of the water should be about 40° F., rarely lower; that of the warm douche may very well be borne as high as 180° F. (Thomson, op. cit. 289.) The duration of their employment must vary very much; in this respect the condition of each patient at the time must be the criterion.

The water used for the douche is rarely medicated, excepting by the addition of salt or of sea-water.

The douche is especially applicable to cases in which it is desirable to invigorate the vital functions, generally, or to increase the tone of particular parts or organs.

In cases of considerable general debility, the system may not be able to react sufficiently if the cold douche is employed at first; here it is best to use the warm water, and gradually, on successive occasions, to lower the temperature of the douche, as the individual may have become stronger. When carefully employed in this way, it is one of the best general tonic remedies which can be made use of.

In local paralysis its good effects are very manifest; as, for instance, when directed upon the lower part of the spine, in cases of paralysis, partial or otherwise, of the sphincter muscle of the anus, or neck of the bladder; in a similar condition of some of the voluntary muscles, as of the deltoid, resulting from an injury to the muscle itself, the douche should be directed upon the particular part. When the loss of power is

more general, the effect of lesion of one of the central organs of the nervous system, it is advisable not to employ this remedy until all the active symptoms of such lesion shall have been removed; such cases demand great watchfulness on the part of the surgeon.

The simplest mode of applying the douche is to pour the water from the nose of a teapot, or pitcher, from some convenient height; if a large stream is desired, a basin or a bucket can be employed. The shower-bath is a common name for a variety of the douche. It is made in numerous ways. A very simple form, and one which is very convenient for surgical purposes, particularly in young patients, "consists of a hollow vessel made of tin, with a perforated bottom. The body of the vessel is of a bell-shape, with a hollow tube rising from the top, (*b*) and terminating in a broad perforated rim.(*c*) When the bath is to be used, it must be sunk in a bucket of water, until it is completely submerged; the air is thus driven out of the bath, which is filled with water. The thumb of an attendant is then to be placed upon the orifice in the centre of the rim, (*c*) and the bath raised from the bucket of water. The pressure of the air upon the holes in the bottom retains the water in the bath, and on raising the thumb from the upper orifice, the water is rapidly discharged." (Fig. 12.) Portable shower-baths, holding from a quart to a gallon or more of water, are now made so that the patient may hold the vessel himself above his head, and discharge the water by raising a valve with his finger. The shower bath may act on the whole surface, or upon a single part which is alone exposed. After its use, the body, or the parts which have been wet, should be thoroughly dried by friction with a towel, and the person covered as soon as possible. The best time for making use of the shower bath,

Fig. 12.



or the douche, if other circumstances will permit, is probably soon after rising in the morning.

SECTION III.

BATHING.

Bathing forms a very important item in the treatment of many surgical diseases, so that a brief consideration of it wil not be out of place here.

Baths are of water, simple or medicated, and of vapour,—of water, or of some medicinal substance; or, again, it may be a simple air-bath; the latter is not much resorted to as a remedial agent.

The water-baths are of most frequent use. For convenience-sake, they may be classed as the cold (temp. 33° to 60° F.); the cool (60° to 75°); the temperate (75° to 85°); the warm (92° to 98°); and the hot (98° to 112°). (Forbes, art. "Bathing," in Cyclop. Pract. Med.) The thermometer, though answering very well as a general index of the temperature of the bath, is really a very arbitrary guide in preparing baths for particular individuals; since a degree of temperature which one person may consider "warm," or "temperate," may to another be disagreeably cold; the feelings of the patient, guided by the judgment of the attendant, constitute a much more rational and a safer guide.

As in the case of the douche, two series of effects are manifest when one takes a bath: the primary and the secondary. These vary in degree, with the temperature of the water. The greater the difference between the temperature of the bath and that of the body, the more marked will be the immediate effects, or the shock; and these will be depressing, or stimulating, as the temperature of the water is below or above that of the surface, and proportionally so. A cool, and still more a cold, bath produces directly a sedative or depressing effect; but in the course of a few minutes, unless the patient be very feeble indeed, the system recovers from this, and an excitement, proportioned to the previous depression, takes its place. This condition continues a longer or shorter time, and a second stage of depression ensues.

from which reaction does not occur, so long as the individual is exposed to the same temperature. After the patient is removed from the bath and properly attended to, the excitement continues for a time, and then gradually the system reacquires its former standard, or retains permanently a moderate elevation.

A hot bath produces immediately an excitement of the system, as indicated by fulness of the superficial vessels, flushing of the face, increased force and frequency of the heart's action, throbbing of the vessels of the head and neck; the latter phenomena are sometimes so strongly manifest as to require the employment of cold applications to the head, and even the use of the lancet. Soon, however, either with or without the aids just mentioned, perspiration breaks out very freely upon the face, the excitement of the heart subsides, and the patient becomes more and more relaxed, and not unfrequently faints; this condition of relaxation continues for a considerable time after the bathing has ceased.

The warm bath generally produces a soothing, tranquillizing influence, allays restlessness, assuages pain, and often induces delightful sleep. The excitement which it causes is very moderate, and if used permanently, it may be considered an excellent tonic, as is the cool or cold bath, under proper regulations.

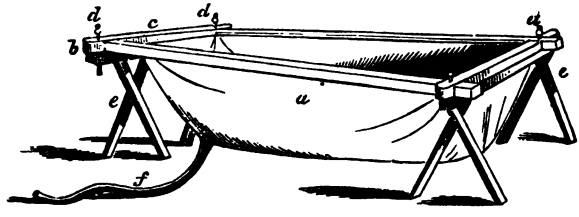
Bathing is, therefore, applicable to a variety of surgical diseases. As a calmative agent, it is employed in numerous subacute inflammations, in many diseases of the skin, &c., &c. As a tonic, it is applicable to cases of general or local debility; as a stimulant, to the same sorts of complaints; as a depressing remedy, it is often made use of to overcome violent pain, spasmodic muscular contraction, as in the reduction of dislocations, to allay spasm of the neck of the bladder, to aid in the return of a hernial protrusion, and the like.

In giving a bath, the water should be preserved, as far as possible, at the same temperature throughout its use. When the bathing is completed, the individual should be carefully rubbed dry with towels, and protected from exposure to a current of air.

Common sense will suggest at the time some apparatus suitable for the administration of this remedy; if possible, it should be large enough to contain the entire person, but in

the absence of such a convenience, a common water-cask might be employed, or a washing-tub;—care being observed, if the bath be warm, to protect, by a blanket, such portion

Fig. 13.



of the surface as may be uncovered by the water. Dr. Thomson (op. cit., p. 296) has contrived a very convenient apparatus for bathing; he thus describes it:—"It consists of a hammock (*a*) of Macintosh's cloth, which is extended upon two long poles (*b b*), passed through a broad seam on each side of the hammock, and kept asunder by the cross pieces (*c c*), which are attached to the poles by the thumb-screws (*d d d*). At one end of the hammock is an air-pillow, which can be readily blown up; and below it, is a flexible tube (*f*), made of the same material as the hammock, by which any water it may contain can be readily drawn off. When the poles are fixed, as in the above figure, and the open end of the flexible tube is twisted around one of the thumb-screws, the bath is ready to receive the water. It may be supported upon two chairs, or upon folding tressels (*e e*). The advantage of this bath is, that it requires a very small quantity of water compared to that demanded for other baths; that it requires no sheet for the bather to rest upon; and, when the bathing is completed, the poles and the folding tressels can be placed aside in a small closet, or in the corner of a dressing-room, and the hammock, when dried, put into a drawer." This apparatus will be found very convenient on board ship, or in camp, where convenience in transportation and economy of space must be consulted. (Fig. 13.)

Partial baths are very often used, and are of great service in many cases. Thus the pediluvium, or foot-bath, may be the means of effecting powerful and efficient derivation from

the head, and of inducing a considerable degree of relaxation of the whole frame. An ordinary bucket may be partially filled with water of as high a temperature as the patient can bear, rendered more powerful, if desired, by the addition of mustard-flour or cayenne pepper, or some liquid stimulant; the patient may sit up in a chair, while the feet are in the water, or he may remain in bed, with his limbs projecting over its edge into the bucket which is supported upon a chair conveniently placed. He should be well wrapped up during the process; from time to time, portions of water should be withdrawn from the bucket, and hot water added. The bath may be continued for fifteen or twenty minutes, or longer.

FIG. 14.



The hip-bath furnishes a very convenient and powerful means of acting upon the lower part of the spinal marrow and the pelvic organs. It may be very well taken in a vessel, of which the annexed drawing illustrates the form; it has the important advantage of well supporting the back, while the patient is in the sitting posture. (Fig. 14.)

Baths are variously medicated to suit particular indications; several of such modifications will be given at the end of the volume.

The VAPOUR BATH may be made to answer many of the indications fulfilled by the water bath; its general effects are very similar. The intensity of its action varies much, according as it is allowed to act upon the surface merely, or as it is inhaled also. Dr. Forbes, (art. "Bathing," op. cit.) gives the following comparative statement, by which it is supposed that the vapour bath produces effects equal to

The tepid bath, at	85°—	92°,	its own temp. being		90°—106°,	90°—100°
" warm "	92°—	98°,	"	"	106°—120°,	100°—110°
" hot "	98°—106°,	"	"	120°—160°,	110°—130°
					Not breathed.	Breathed.

Their administration is very simple, and is attended with less inconvenience, oftentimes, than the use of the water bath. The readiest mode of giving a vapour bath is to seat the patient upon a chair, and at his feet place the vessel of water sufficiently heated; surround the whole,—patient, chair, and

water,—with a blanket, or a mantle of waxed or oiled cloth, or of India-rubber cloth,which may envelope the head, if it be considered advisable that the vapour be inhaled, or simply enclosing the neck if otherwise; to keep the water at a proper temperature, a heated brick may be immersed in it, or the vessel placed upon it, from time to time, as required by the lowering temperature of the fluid. If the patient remain in bed, a flexible tube can be easily introduced beneath the bedclothes, communicating with the interior of a vessel, as an ordinary tea-kettle, in which vapour is being generated: or a plate containing the fluid and a hot brick may be placed in the bed, and an arched framework thrown over it to protect the bedclothes.

SECTION IV.

ON FUMIGATIONS.

When solid substances are vaporized, and thus made to act upon the surface, as medicinal agents, the process is called *Fumigation*, and is effected by placing the substance to be used in contact with a body heated at a sufficient temperature, and so arranging the position of the patient as that the fumes may come in contact with his surface. The arrangements recommended above in the application of the vapour bath may be employed likewise in fumigating; the same, or even greater, care being observed to protect the air-passages, if the fumes are irritating, or not intended to be inhaled: again, a large box, or a hogshead, may answer very well, being so contrived as that the head may be guarded against the vapour.

The articles most frequently employed in fumigating the surface, or a particular part of it,—are sulphur, nitre, cinnabar, arsenic, benzoic acid, chlorine gas, nitrous acid, &c., &c.

Vapours, whether by the vapour bath, or by fumigation, are chiefly employed in affections of the skin, some forms of chronic rheumatism, periostitis, and the like.

SECTION V.

ON DISINFECTING AGENTS.

A pure atmosphere is one of the most important requisites in the treatment of disease, and it is one which, in surgical practice particularly, is difficult of acquisition oftentimes. It becomes necessary, therefore, that the surgeon should devote some attention to this matter.

The method which suggests itself most naturally to the attendant is, to effect as perfect ventilation as circumstances will permit. For this purpose, some method should be adopted whereby the air in the patient's apartment shall be frequently renewed by the introduction of fresh air from without, displacing that within the room. When the temperature is such as to admit of keeping a fire in the chamber, the vitiated atmosphere will ascend freely through the chimney, thus allowing pure air to take its place; but in warm weather this source of purification is cut off, and the surgeon is obliged to rely chiefly upon the windows and doors, as affording avenues through which an interchange may be effected of the air within and without. This mode of purification may be much aided by the use of various disinfecting agents, which neutralize, more or less, the exhalations and effluvia within the sick-room. Of these, the various substances which contain chlorine are most in use. They probably produce their effect by the liberation of chlorine gas, which combines with the offending gases. The chlorides of calcium and of sodium are the compounds generally employed as disinfectants; they are used in a solid state, placed in different parts of the room, in some suitable dish, and kept moistened with water, or with dilute sulphuric acid, which is still better; or they may be rendered liquid for application to the surface of the body and to the bedclothes of the patient. The liquid chloride of calcium may be prepared thus:— Introduce into a common glass retort fourteen parts of black oxide of manganese, six parts of chloride of sodium, the same proportion of sulphuric acid, and twelve parts of water. The chlorine gas will be evolved without the aid of heat applied.

and should be transmitted through a tube attached to the neck of the retort to the bottom of a vessel filled with a saturated solution of lime, until the evolution ceases. The water thus impregnated should be diluted with about forty parts of fresh water, for ordinary use.

The liquid chloride of sodium is prepared in the same manner: a solution of one part of sub-carbonate of soda, in twenty parts of water, being substituted for the lime-water. The solution should be diluted with about thirty parts of water. These liquids are sprinkled upon the patient's clothes and bedding, and a portion may be added to the water used in washing any diseased part: for this latter purpose, the solution of the chloride of sodium is generally preferred, (Cyclop. Pract. Med.)

Labarraque's solutions of these chlorides are now sold very generally throughout the country.

A solution of the chloride of zinc is also employed as a corrector of the atmosphere.

Chlorine gas may be very easily liberated from common salt, by pouring concentrated sulphuric acid upon it, in the proportion of one part of the acid to three parts of the salt.

An objection to the use of the chlorides arises from the smell of the preparations themselves being disagreeable to many persons.

Fumigations by nitrous acid vapour have been resorted to, and with much success. The vapour is obtained by the action of sulphuric acid on nitrate of potassa, in equal proportions, without the aid of heat; care is necessary lest the fumes be disengaged too rapidly and too abundantly, and thus prove a source of irritation to the respiratory muscles.

The common quicklime possesses the power of absorbing many of the gases on which the noisome atmosphere of the sick room depends. It is placed in plates, or other dishes, and set in various parts of the chamber.

M. Le Doyen has recently recommended a disinfecting agent which seems to possess many advantages over the others, and a very important excellence of this preparation is, that it has no odour itself. It consists of a solution of the nitrate of lead, and can be prepared by dissolving litharge

in one part of nitric acid, mixed with about ten parts of water. It is used in the same way as the liquid chlorides.

To insure any degree of purity of atmosphere, it is absolutely essential that the patient's apartment be kept clean, and that all useless clothing and furniture, which may attract offending gases, be removed. The dressings which have been changed, the water with which diseased parts have been cleansed, all vessels containing discharges from the patient, should be taken out of the room as soon as possible. Frequent white-washing of the walls and ceiling of the chamber will conduce very much to the preservation of a pure atmosphere, probably on account of the absorbing property of the lime over the effluvia.

The most efficacious method for disinfecting substances, such as clothing, which retain infectious agents, is to expose them to an elevated temperature, as, for example, a temperature of 200° or more, of Fahrenheit's scale; the heat may be employed dry, or in the form of steam. The action of heat is effectual in a very much shorter time than an ordinary current of air.

PART II.

ON BANDAGES AND THEIR APPLICATION.

CHAPTER I.

BANDAGES are employed in surgery to retain dressings upon the surface of the body, or other applications; and also as a means of restoring and confining to their natural situation parts which may have become displaced.

The materials used for bandages are generally muslin, linen, flannel, or calico: sometimes gum-elastic cloth may be employed. Of these materials that which is most frequently selected is muslin, either bleached or unbleached; it is cheap, and everywhere to be found. Flannel is, in some circumstances, preferable to muslin, in consequence of its greater warmth and elasticity.

Bandages are *simple*, as when formed from the roller; or *compound*, when prepared from one or more pieces adapted by size and conformation to particular objects.

We shall first describe the different bandages commonly employed, and then treat of their several uses, as applicable to the different regions of the body.

SECTION I.

THE ROLLER, OR SIMPLE BANDAGE.

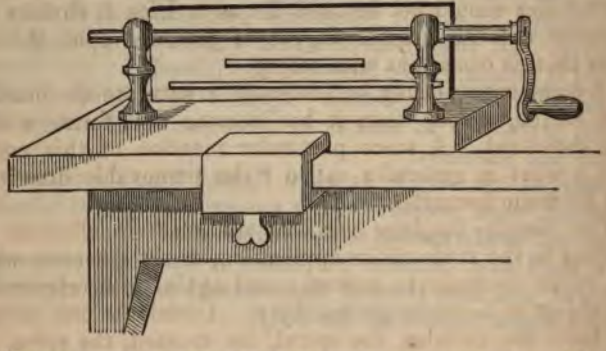
There are but very few of the ends ordinarily to be attained by bandaging, which may not be gained by a skilful dresser with the simple roller.

It is prepared from any of the materials above-mentioned, but for general purposes muslin is selected. It should be torn or cut into strips, varying in length and width, according to the part to which it is to be applied, and rolled into

the form of a solid cylinder: this latter object may be effected by the hands alone, or by making use of a very simple machine contrived for the purpose. If rolled by the hands, the strip should be folded at one extremity several times, until it shall have acquired a certain degree of solidity; then the ends of this axis are held, and its mass made to revolve, between the thumb and forefinger of the right hand, while the free portion of the strip is pressed by the thumb and forefinger of the left hand, and allowed to pass from between them, smoothly, and with some degree of tension, as the cylinder is gradually forming.

Figure 15 presents a view of a machine for rolling the simple bandage: it sufficiently explains itself.

Fig. 15.



If but a single cylinder is formed, the roller is said to be "single-headed;" if there be a cylinder rolled at each extremity of the strip, it is called "double-headed," and the unrolled portion between the two cylinders is termed the "body" of the roller.

In applying this bandage, the external surface of the free extremity of the roller is laid upon the part, and retained there by the fingers of the left hand, until fixed by a few turns of the roller, the cylinder being held in the palm of the right hand by the thumb and fingers; care is necessary that the bandage be laid smoothly and evenly upon the surface, and that a uniform degree of pressure be exerted by each successive turn. After the rolling is completed, the free

extremity of the bandage is most easily confined by a pin inserted transversely, or if parallel with the length of the bandage, the pin should be introduced with its point towards the free end of the roller, otherwise it is liable to be drawn out by the constant strain of the bandage upon it. When the part to which the bandage has been applied is very small in circumference, and the bandage itself very narrow, the extremity of the latter may be conveniently attached by slitting it longitudinally through the middle, and tying the ends around the part; as, for example, the finger or toe.

Sometimes the roller may be wetted previous to its application, as, for instance, when it is used to confine the band to which the pulleys are attached, in the process for reducing a dislocation; the band is thus more firmly secured than when a dry roller is employed. But in ordinary cases of bandaging, a wet roller should not be used, for as it dries, it shrinks and produces a much greater degree of pressure upon the soft parts than is consistent with safety.

In some cases it may be advisable to saturate the bandage with starch, which, when it has become dry, forms a stiff, firm casement. A more particular mention of this, constituting what is generally called "the immovable dressing," will be made hereafter.

The simple bandage receives different appellations according to the mode of its application, or the direction which the roller is made to assume; and again, with reference to the object to be accomplished by it. Under the first division we have the circular, the spiral, the crossed, the spica, and the recurrent bandages. The second division embraces the uniting, the dividing, the compressing, the expelling, and the retaining bandages.

1. The CIRCULAR is that of which the folds are horizontally disposed, or nearly so; each successive fold almost completely overlapping that which preceded it. (Fig. 16, *a*.)

2. The SPIRAL ascends obliquely around parts more or less conical in form, each fold of the roller applying itself smoothly and flatly to the surface. Sometimes the edges of the roller overlap each other at each successive turn, when the bandage is termed by the French, "en doloires; sometimes a space intervenes between the folds, in which case it is termed "rampant:" fig. 16, *c* and *b*. If a limb, or any

other part of irregular form, is to be bandaged in its length, it will be impossible to cover its surface wholly, and at the same time to make equable pressure upon it at all points, by simple spiral turns: one of the edges of the roller will compress the surface more or less tightly, while the other will be loose. In order to obviate this difficulty it is necessary to reverse the turns of the roller, from time to time, as the varying form of the part may require: fig. 16, *d*. Some considerable practice is needful to enable the dresser to make these reverse turns rapidly and neatly. The object is to reverse the relative positions of the edges and surfaces of the bandage, whereby its superior edge shall become the inferior, and the external face the internal.

Fig. 16.

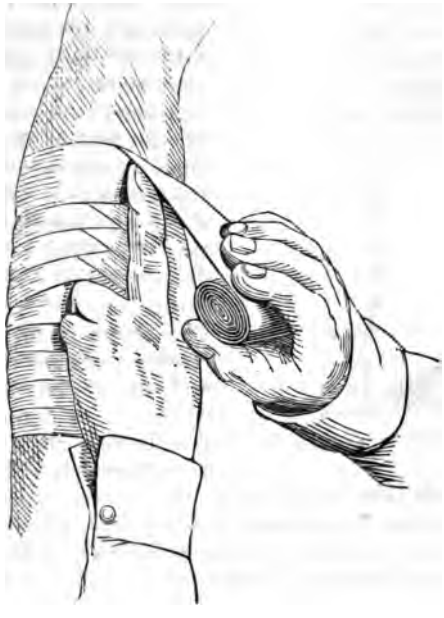


To accomplish this end properly, the spiral should be discontinued so soon as the bandage ceases to apply itself smoothly and flatly to the surface; at this point two or more fingers of the left hand should be laid upon the roller at its superior edge, and the right hand, in which the cylinder is held as before directed, and which, until now, has been kept supine, should be pronated, while the body of the roller, thus reversed, is suffered to apply itself, without traction, partly upon the preceding fold, and partly upon the surface which is to be covered; then the cylinder is carried around to the opposite side of the limb, and the process just described repeated. "The hand should press tightly upon each reverse to flatten and equalize it. (Fig. 17.)

"Two precautions are to be observed in applying the reversed bandage; one is, not to unroll, in making the angle, more of the band than is absolutely necessary; the other, to carry the angles upwards in a perpendicular line, and always

far from the part affected," in order that the increased thickness of the bandage at the angle or fold, shall not produce a corresponding pressure and indentation upon the diseased or injured surface. (Cutler, p. 25.) Each successive turn of

Fig. 17.



the roller should overlap from one-third to one-half of that which preceded it, the edges being made, as far as possible, parallel with each other.

3. The CROSSED bandage is made by giving the turns of the roller the form of the figure 8, as is exemplified in the annexed drawing (fig. 18), in which the bandage is supposed to be applied to the bend of the arm after the operation of phlebotomy, to compress the incised vein.

4. "When the turns of the roller cross each other in the form of the Greek *lambda*, and leave the band about one-third discovered, the Λ's being applied upon each other, the bandage

receives the name of *spica;* fig. 16 *e*: it is said to be ascendant when the doloires are directed towards the superior part of the member, and descendant when they regard inferiorly." (Cutler, p. 25.)

Fig. 18.



5. The RECURRENT bandage is applied to the head more frequently perhaps than to any other part. It derives its name from the fact that the roller, after covering a certain portion of the surface, is reflected in its course and brought back to its original point of departure, at which it is again reversed towards the opposite point. This process is continued until the entire surface is covered; each successive fold overlaying one-third, or more, of that which preceded it, and being confined at its point of reflection, temporarily by the fingers, and permanently by pins or by a circular turn of the roller, when the bandaging is completed. It forms an exceedingly neat and beautiful dressing.

The same bandage is employed as an envelope to stumps, after amputation, for the purpose of retaining the other applications which have been made.

1. The UNITING bandage, as it has its almost exclusive application to the treatment of wounds, will be considered when that class of affections is treated of.

2. The DIVIDING bandage is employed in the treatment of burns and granulating surfaces, where there has been much loss of substance, and where unsightly cicatrices are liable to be formed, and deformities from the approximation of opposed surfaces. The object of this bandage is, to obviate such apprehended difficulties by maintaining a proper separation of the parts: thus, for example, when the anterior face of the neck has been deeply injured by a burn, the lower jaw and the head should be prevented from being drawn towards the chest, as the ulcer cicatrizes, by means of a dividing bandage, having its *point d'appui* around the shoulders and in the axillæ. It is generally formed of the simple roller.

3. The COMPRESSING bandage, as may be inferred from its

name, is employed to exercise pressure upon a superficial, or a deep-seated, part. Sometimes the roller is used alone, sometimes its action is assisted by a compress.

4. The EXPELLING bandage, like the one last mentioned, consists of a roller, generally applied over a compress. It is employed to facilitate the expulsion of fluids from morbid cavities and canals.

5. The RETAINING bandage is used to confine dressings in place, as also parts of the body which, having become removed from their natural positions, are replaced.

6. The KNOTTED bandage is sometimes advantageously employed to arrest bleeding, particularly of the temporal artery; it will be described hereafter.

The ability skilfully and neatly to apply and adjust the roller, is of very great importance to the surgeon; and the time which the young dresser devotes to its acquisition is well spent. It can only be gained by frequent practice; verbal descriptions, and the best executed illustrations, should be considered merely as guides and aids; they cannot impart practical skill, any more than the perusal of volumes on anatomy, to the exclusion of dissections, can render the student acquainted with the mysterious construction of his material frame. Let each one, therefore, spend a few leisure moments every day, with some companion, in the practical application of the roller: at first, reference to some book on bandaging will be necessary, but after a certain degree of skill has been acquired, the volume may be laid aside; the student's good sense, and the familiarity which he has already gained with the mode of bandaging, combined with his knowledge of the particular object to be attained in each case, will be his best guides and his best adviser. The more skilful he becomes in the management of the roller, the more entirely will he be able to dispense with compound and complicated bandages; the more capable will he be to accomplish all that he desires by this simple means.

SECTION II.

COMPOUND BANDAGES.

These are intended to fulfil some especial indication, which owing, it may be, to the peculiar conformation of the part or parts involved, cannot be so well attained by the simple roller. They are formed of one piece, or many pieces, of muslin, or of some other material, to which are given a shape and conformation varying according to the judgment of the dresser. There are some bandages, however, so commonly made use of, that they require particular description. Such are the crucial, or, as it is generally called, the T bandage; the invaginated; the many-tailed, or the split; the laced; the sheath, and the suspensory bandages.

1. The T bandage derives its name from its shape. It consists of a horizontal band to which is attached another at about its middle, having a vertical direction, perpendicular to the first; when there are two vertical bands, it forms the double T bandage. The length and breadth of the strips vary with the dimensions of the part of the body to which the bandage is to be applied, and the particular end which it is expected to secure. Sometimes, as for example, when it is employed to retain dressings upon the hand, one of the bands is perforated to admit of the insertion of the fingers.

2. The INVAGINATED bandage is used to approximate the edges of wounds, or fragments of bone, as in fracture of the patella. It is made in two different ways, according to the indication to be fulfilled by it. Thus, if the object be to draw together the lips of a longitudinal wound of a limb, a roller should be selected corresponding in width to the length of the wound, and long enough to be passed several times around the limb. At its free extremity it should be slit into two or more tails of a convenient length, and corresponding fenestræ be made in the band at a distance from the end rather greater than the circumference of the limb. In its application, the undivided portion of the band should be placed opposite to the wound, and the tails passed through the fenestræ, thus surrounding the limb; then, with a compress placed near each lip

of the wound, its edges should be gently but accurately approximated, and retained in apposition by several turns of the roller. For an illustration of this, see the Chapter on Wounds.

The invaginated bandage for transverse wounds, fracture of the patella, &c, is made upon the same principle precisely; it consists of two bands of convenient length and width, and of two rollers. Slits, as in the other bandage, are made at one end of one of the bands, and corresponding fenestræ near one extremity of the other; then, by means of the rollers, firmly attach the bands to the limb, the one above and the other below the wound, or the point of fracture, and having passed the tails of one through the fenestræ of the other, draw the divided parts together, and confine them in this position by successive turns of the roller. If necessary, compresses may be used, as in the other case.

3. The SPLIT or TAILED bandage consists of a piece of muslin, or of some other fabric, divided at its extremities into a convenient number of tails, leaving the central portion of the band entire. Or a piece of muslin of the proper dimensions may be selected, to each extremity of which bands of suitable length and width shall be attached. Constructed after either method, this bandage is very useful and convenient in confining dressings.

A very elegant modification of this bandage consists of a number of strips, varying in width from two to four inches, generally, and sufficiently long to extend about once and a half around the affected part, as the leg: these strips are so placed upon each other, successively, that each has about one-third of its width covered by that which succeeds it in the order of super-position, commencing from above. The strips, so arranged, may be attached in mass along the centre, by means of a needle and thread, thus constituting the bandage of Pott, or they may remain unconnected, forming the bandage of Scultetus; the last possesses this great advantage over the other, that any strip, or strips, which may have become soiled, can readily be withdrawn without deranging or removing the others, by simply pinning the fresh band to the extremity of that which is to be rejected, and drawing it to the situation occupied by the latter in the bandage.

These divided bandages form very light retaining and com-

pressing dressings, and present an exceedingly neat and elegant appearance, when carefully adjusted. That of Scultetus is the one most frequently used.

4. The LACED bandage is made of some more or less elastic material, as buckskin, flannel, or caoutchouc, so shaped as to correspond accurately to the contour of the part to which it is to be addressed, and retained in situ by means of straps and buckles, or cords passed through a series of eyelet-holes, ranged along the edge of each flap.

The laced bandage may be advantageously applied to any part of the surface, upon which a constant and equable pressure will be useful; its most frequent employment, however, is around the joints, in some chronic affections, and on the leg in case of varicose veins.

A very good substitute, in many instances, for the true laced or buckled bandage will be found in a knit woollen band of suitable width, having its two extremities firmly sewed together, thus forming a circlet somewhat less in circumference than that of the affected part, and capable, thereby, of imparting firm and elastic pressure around it. Or a similarly shaped band of gum elastic cloth may be used, with care to protect the skin from its irritating effects by lining it with linen, or by inserting a piece of linen, or silk, between the skin and the band.

5. The SHEATH comes to hand already prepared for use, in the fingers of a glove; or when a larger envelope is needed, it may be easily made after this pattern, of any suitable material. It is serviceable as a means of retaining applications upon the fingers, toes, or penis, and will be found to be much better adapted to this purpose than a narrow roller, which cannot be very neatly and conveniently arranged upon these parts, owing to their situation and size.

6. The SUSPENSORY bandage is intended to afford support and protection to particular parts, as the nose, penis, or scrotum. In its simplest forms its preparation is easy, being made of a piece of muslin or linen of convenient shape and dimensions, and having bands or pieces of tape attached to it, for the purpose of retaining it in position. In the stores in which surgical apparatus is sold, suspensory bandages for the scrotum will be found very elegantly made of network.

SECTION III.

M. MAYOR'S SYSTEM OF BANDAGING.

Struck with the little change and improvement effected during the preceding half-century, in that branch of surgery which is the subject of this volume, and aware of the difficulty often experienced, in some situations and circumstances, in securing a constant supply of the materials ordinarily employed in surgical dressings, M. Mayor, Chief-Surgeon to the Hospital of Lausanne, Switzerland, has originated and developed a new system of bandaging. In the year 1832, he published a treatise on this subject, entitled, "Nouveau Système de Déligation Chirurgicale," which has now passed through three editions. The object which M. Mayor had in view in his investigations was, "To discover some simple means, easy of application, always at hand, or readily procurable, and well adapted to serve as a substitute for charpie, compresses, cushions, bands, bandages, and ligatures, which surgery requires for all sorts of dressings." His researches and practical experience have at length led him to the conclusion, that he has succeeded "in reducing, as far as is practicable, all kinds of apparatus to their simplest form, by associating them under one common principle; so that the different parts of such apparatus, and the materials for all dressings, will be found to be so common and of such nature, that they may be always, or nearly always, at the disposition of the surgeon, and of all other persons, and in the absence of the practitioner, may be readily applied, after some little instruction, by the first comer." (Op. cit. 3d ed. p. 16 of the Introduction.)

The whole 'materiel' of M. Mayor's system of bandaging may be reduced to a single square piece of muslin, or other suitable fabric; or, in the absence of this, an ordinary pocket handkerchief, or a square cravat. From this primary form he makes four others, which constitute his whole array of bandages; these are the oblong band, made by folding the square several times, until the desired width be attained; the triangular, formed by folding the square diagonally; the cravat, prepared from the triangle, as the cravat for ordinary wear is

made; and the cord, which is merely the cravat rolled into the form indicated by the name. With these simple forms of bandage, M. Mayor proposes to replace all the ordinary bands and bandages of surgery. He contends that all or nearly all the indications which can be fulfilled by the latter, are equally well attained by the former, while these are always at hand in town and in the country, at sea or on land, in civil and in military practice.

The above is a mere sketch, an outline, of M. Mayor's plan. For a detailed account of it, and for its adaptations to particular cases, the reader is referred to the treatise itself. The system is very simple, and its applications may be acquired without difficulty. Where the object is merely to confine dressings, or to protect parts of the surface, or to support a limb, the simple means recommended and employed by M. Mayor will probably be found perfectly efficacious; but in the treatment of fractures, and in cases requiring well-regulated and firm compression, the author is inclined to think that they cannot be advantageously substituted for the roller and other bandages, ordinarily employed, excepting as temporary means, or in the absence of the others. In justice to M. Mayor, it must be observed, that he himself admits that there are some circumstances in which his own system of bandaging will be found less serviceable than the other.

In the different sections on regional bandaging, the author will give such of M. Mayor's dressings as seem to him to be most worthy of attention. As an admitted system for practical adaptation, it is not, according to the most accurate information which the author has been able to obtain, employed in any country; he deems it, therefore, superfluous to give its details.

CHAPTER II.

REGIONAL BANDAGING.

SECTION I.

BANDAGES FOR THE HEAD AND NECK.

1. The RECURRENT bandage of the head is composed of a single-headed roller about five yards long and two inches wide.

APPLICATION.—The initial extremity of the roller is placed upon the lower part of the forehead, or on the temple, or occiput, and confined by a few turns circling around the head in a line running from just above the eyebrows to a point a little below the occipital protuberance: at the middle of this line, as at the forehead, the course of the bandage is reversed, and the reversed turn held by a finger of the left hand, while the cylinder of the roller is carried over the top of the head along the sagittal suture, to meet the circular turns at the occiput; here a reverse is made again, and confined by an assistant, while the cylinder returns in an elliptical course to the forehead, where it is retained upon the first reverse by the finger of the dresser. In this manner successive reverses are made at the forehead and occiput, and repeated returns of the roller to and from these points in elliptical folds, each successive fold overlapping about one-third of the preceding, until at length the side of the head is completely covered. The other side is covered in the same manner by successive folds similarly overlaying each other, and the bandage completed by circular turns firmly applied over the common points of reverse, in front and behind: to render the dressing still more secure, a single turn of the roller, commencing at the middle of the last circular, laterally, may be passed beneath the jaw, to terminate at the corresponding point of the circular on the opposite side. Pins

Fig. 19.



should be inserted in the bandage to confine the reversed turns, at the forehead and occiput, and one also at the extremity of the roller. (Fig. 19.)

Use.—To retain dressings upon the scalp, and to exercise moderate pressure where such may be required.

2. The T bandage of the head is composed of a band two yards long and two inches wide, to which is attached, at right angles, another strip of the same width and half a yard in length. The longer band is then rolled into two cylinders.

Application.—The dresser, taking his station in front of the patient, applies the bandelette to the top of the head, over which it passes to the nape of the neck, while the longer portion of the bandage starting from the middle of the forehead, circles around the base of the cranium, on each side, to the occiput, where, just beneath the occipital protuberance, it meets the vertical portion; the latter having been crossed and confined in this position by the other division of the bandage, is reflected over the vertex to the forehead, where it is retained by the folds of the longer band which expends itself in circular turns.

A double T bandage may be used instead of the single, if more convenient; in either case, the course of the limbs of the bandage may be more or less varied to suit particular purposes.

Use.—To retain dressings upon the scalp.

3. The four-tailed bandage of the head is formed of a piece of muslin one yard long and six inches wide, split at each extremity to within about three inches of the centre.

Its application may be varied according to the part of the head upon which it is intended particularly to act.

"When the wound is on the forehead, the unsplit portion is applied there, and the two upper tails, carried posteriorly, are fixed at the back of the head; the lower tails are then fastened either upon the vertex or beneath the chin, as the surgeon may consider it most convenient.

Fig. 20.



"To confine a dressing upon the summit of the head, the posterior tails, (*a*, fig. 20,) are brought down and secured beneath the chin; the anterior tails (*b*, *b*,) after being carried to the nape of the neck and crossed, are fixed before the throat.

"In applying it to the nape of the neck, the upper tails are conducted over the forehead, from whence, after being made to cross each other, they are returned, and fastened at the occiput; the lower tails pass round the neck." (Cutler.)

Use.—As the last.

4. The six-tailed, or the bandage of Galen, consists of a piece of muslin a yard long, and a quarter of a yard wide, split at each extremity, to within three inches of the middle, into three portions, of which the central is rather the widest.

Application.—Place the unsplit portion, *a*, of the bandage upon the top of the head; then folding the edges of the central, *b*, tails inwards, so as to give them a triangular form, the base of the triangle being at the top of the head, draw the tails down over the ears and tie their extremities beneath the chin. Reverse the relative position of the anterior and posterior tails, bringing the latter, *c*, to the front, where they shall cross each other upon the forehead, and be confined: while the anterior tails, *d*, are drawn round to the occiput, are crossed beneath the protuberance, and retained, as on the forehead, by pins. (Fig. 21.)

Use, as the preceding, over which it possesses a superiority in being more secure, and in covering a large surface of dressing.

5. The fronto-occipital triangle of Mayor, serves very well

the purpose of a retaining bandage. Its *application* is very simple: place the centre of the base of a triangle upon the

Fig. 21.



forehead, just above the superciliary ridges, while the body of the triangle covers the top of the head, the apex hanging down upon the back of the neck; draw the tails around the base of the cranium to the occiput, cross them beneath the protuberance, and then continue them respectively to the temples, or forehead, and confine their extremities by pins. The apex of the triangle, overlapped at the occiput by the tails, is reflected upon the latter, and, being continued upwards upon the body, is pinned.

The occipito-frontal and the bi-temporal triangles are applied in the same manner as the last, excepting that in one case the base of the triangle is laid upon one of the temporal regions, and in the other upon the occiput.

Uses, the same as of the bandage of four tails, &c. They are much more simple in their application than those heretofore described, and may very well supersede them.

6. The knotted bandage is composed of a double-headed roller four yards long and two inches wide, and of a graduated compress.

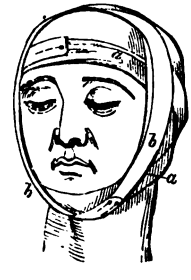
APPLICATION. — Place the compress over the wounded artery, and apply upon it the body of the roller; then conduct the heads around the cranium, one over the brow, and the other over the occiput, to cross each other at the opposite temple, whence they are returned to the compress; on reaching this point they are twisted upon each other, and their courses changed, one mounting over the top of the head, the other descending beneath the chin, and both made to cross again at the opposite temple, after which the same route is continued to the compress, where a second twist is effected, and the course of the roller changed to the horizontal direction, as at first; again the heads cross each other upon the temple of the sound side, the compress is again reached, and a third twist made, after which the vertical course of the roller is resumed, and the bandage completed by a few circular turns.

USE.—To arrest hemorrhage from the temporal artery. This somewhat complicated bandage may be very properly superseded by a simple roller, and a compress which shall be retained and pressed upon the bleeding vessel by a few circular turns.

7. The four-tailed bandage of the chin is composed of a strip of muslin a yard long and three inches wide, and split longitudinally from each extremity, so as to leave but three inches of the central portion of the band undivided.

APPLICATION.—Place the middle of the band upon the chin, and carry the two upper tails, *a*, *a*, along the base of the lower jaw around to the nape of the neck, where they are crossed, and afterwards conducted along the base of the cranium to the forehead, and there secured. The lower tails, *b*, *b*, ascend over the base of the jaw and the sides of the face, in front of the ears, to the top of the head; here they cross each other and then descend, each on its respective side, to the base of the jaw, and are confined beneath the chin, (fig. 22).

FIG. 22.



To increase the pressure exercised by this bandage, a compress may be applied upon any desired point.

USE.—To retain dressings upon the chin; it is also used in fractures of the lower jaw, and in dislocations of its condyles after reduction. For the same purposes the bandages for fracture of the lower jaw, invented by Drs. Barton and Gibson, of this city, may also be applied. (See Fractures of Lower Jaw.)

8. The T bandage of the ear is formed of a horizontal limb two yards long and two inches wide, and of a vertical strip of the same width and half a yard in length.

APPLICATION.—Place the vertical limb upon the ear, and exhaust the horizontal band in circular turns around the base of the cranium, passing just above the ear and over the forehead and occiput; then conduct the vertical limb beneath the jaw, up over the opposite side of the face and the top of the head to the point whence it started, and confine its extremity to the horizontal band.

USE.—To serve as a means of retaining dressings upon the ear.

9. The double T bandage of the nose is composed of a band one yard long and half an inch wide, upon the middle of which are attached at moderately acute angles, and at the distance of one inch from each other, two other strips half a yard long and of the same width as the first.

APPLICATION.—The middle of the horizontal band is placed upon the upper lip, and its extremities are conducted below the lobe of the ear on each side to the nape of the neck, where they are tied in a bow-knot. The other strips are then carried obliquely upwards over the top of the head, crossing each other at the root of the nose; having reached the occiput, they are inserted beneath the horizontal band, over which they are reverted upon the back of the head and confined, (fig. 23).

FIG. 23.



USE.—To retain dressings upon the nose.

10. The sheath of the nose is thus prepared: "A piece of linen is cut into a triangular form, of a sufficient size to cover the nose, with two holes perforated near the inferior angles

to correspond with the nostrils; a triangular portion is cut out from the superior angle of this, the apex of which looks downwards upon the median line of the nose, and the divided edges are sewed together; thus a sort of bag is formed, capable of exactly lodging the nose. To the lower part of the bag is stitched a narrow band, half a yard long and half an inch wide, and to the summit a second band of like dimensions.

"APPLICATION.—The bag is applied upon the nose; the surgeon lays hold of the inferior tails, and, passing them beneath the ears, ties them in a bow upon the nape of the neck; he then conducts the superior tail along the sagittal suture as far as the transverse band, under which he passes it, reflecting the end upwards to secure it upon the descending portion."

USE. — The same as of the foregoing. (Cutler, p. 61.)

11. A simple bandage for both eyes may consist of a strip of muslin two inches wide, and three feet long, of which the central part is placed upon the eyes, and the extremities tied upon the occiput.

USE. — To retain dressings upon the eyes.

If the object be merely to protect the eyes from the light, without exercising any compression upon them, it may be very conveniently attained by attaching to each side of a piece of muslin, or of green silk, of sufficient length and width to cover the eyes, a piece of tape, and then tying the two upon the occiput. Or the silk, or muslin, may be inserted beneath the lower edge of a strip which passes just above the superciliary ridges, around the base of the cranium to the occiput, where its extremities are tied. By this latter arrangement cold or warm lotions may be applied to the eyes, or to one eye only, simply by saturating the pendulous flap, made in this case of linen.

12. The monocle, or bandage for one eye, consists of a single-headed roller four yards long and two inches wide.

APPLICATION.—Two circular turns are made around the head, crossing the forehead and occiput, after which the course of the roller is somewhat depressed, traversing the nape of the neck and passing beneath the ear of the affected side, to ascend obliquely towards the affected eye, which it crosses diagonally; continuing the same direction, it mounts over the fore

head and side of the head, crossing the top of the parietal suture, to descend again to the nape of the neck, from which point it renews its course, as just described. Two or three successive turns are thus made obliquely around the head, in the form of doloires presenting inferiorly, *a*, *a*, *a*; and the bandage is then terminated by circular sweeps around the forehead and occiput, *b*, *b*, (fig. 24.)

Fig. 24.



Use.—To confine dressings upon the eye.

13. The invaginated bandage for the lip consists of a double-headed roller, from two to three yards long, and three-fourths of an inch wide, and of two small compresses.

Application.—Place the body of the roller upon the forehead, and conduct the heads, on each side respectively, around the cranium to the nape of the neck; cross them at this point, and then carry them beneath the ears to the upper lip, over the compresses previously placed near to, and parallel with, the edges of the wound; make a longitudinal slit in one of the tails, opposite the centre of the lip, and through it pass the other head; make, very gently and gradually, a sufficient strain upon the heads of the roller, and conduct them again to the nape of the neck, and thence to the forehead; repeat this process until the requisite support is acquired for the lip, and then confine the extremities of the roller, in the customary manner, (fig. 25).

Fig. 25.



Use.—To approximate the edges of transverse wounds of the lip, and to give support, also, to the hare-lip suture, or to replace it after the withdrawal of the pins.

14. A sheath for the tongue has been contrived by Pibrac, to serve as a means of confining it, in some measure, when

wounded. It consists "of a little purse, *a*, for enclosing the point of the tongue, having attached to its base two silver wires, which are to be bent underneath the chin; to this frame two ribbons are appended, which pass from the chin backwards, beneath the ears, to the nape of the neck, and thence ascend to be tied across the forehead." (Velpeau, op. cit., vol. i. p. 198.) —(Fig. 26.)

Fig. 26.



15. The mask for the face is made of a piece of muslin, or linen, as large as the face itself, having apertures cut in it to correspond with the eyes, nostrils, and mouth, and a strip of muslin attached to each angle.

Application. — Place the mask upon the face so that the apertures shall be accurately adapted to the parts for which they were intended; carry the superior strips along the base of the cranium to the nape of the neck, cross them there, then conduct them round to the chin and tie them upon the mask; cross the inferior bands also upon the nape of the neck and terminate the bandage by knotting them upon the forehead.

Use.—To serve as a simple covering to the face, and to confine dressings upon it.

16. The cervical cravat of Mayor consists simply of a triangular piece of muslin, or an ordinary handkerchief, folded to the form of a cravat.

Application.—Place the centre of the cravat opposite the larynx, the side of the neck, or the back of the neck, as may be most proper, and tie its extremities at the opposite point.

Use.—To retain dressings.

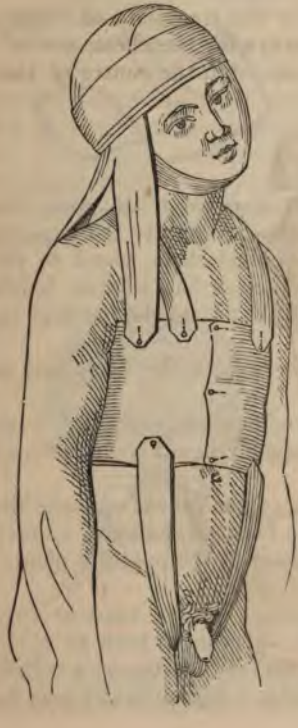
A simple piece of muslin or flannel is often used as a retaining band, in this region. The objection to such an application, as commonly prepared, is that it soon becomes rolled, and ceases to cover the part properly. This difficulty may be

obviated by a simple method: take a piece of flannel or muslin, rather longer than the circumference of the neck, and wide enough to cover it completely; fold it upon itself in its length, and cut from its anterior border, while folded, a triangular piece, of which the base presents upwards; then sew the cut edges together, and unfold the band, which has thus acquired the form of a common stock, and will not become corded when worn upon the neck. Its extremities should overlap each other, and be confined by pins, posteriorly.

17. The flexor bandage of the neck, which appears to be the most secure, and at the same time the most simple and convenient, is the one described by Velpeau, (op. cit. p. 203).

It consists of a strong muslin cap for the head; a band of stout material, three or four inches wide and about three-fourths of a yard long; a roller two yards in length, and a circular bandage for the chest, (to be described in the next section,) with shoulder and pelvic strips attached.

Fig. 27.



Its mode of application varies somewhat with the indication it is intended to fulfil.

If it be employed in the treatment of a transverse wound of the neck, for instance, it is thus applied: Fix the cap firmly to the head by means of a band passing under the chin; place the undivided portion of the strong band above-mentioned upon the top of the head, its extremity reposing upon the occiput, while the split portion of the same band hangs down over the face upon the chest; secure it firmly upon the head, in this position, by several circular turns of the roller, and then, having flexed the head to the requisite

degree upon the anterior face of the neck, pin the tails of the band, at a convenient distance from each other, to the thoracic bandage which has been previously applied to the chest.

The same may be used as a dividing bandage by simply reversing the relative positions of the extremities of the band, the undivided end being placed upon the forehead, and the split portion hanging down over the occiput, so that the head may be flexed backwards on the neck, or maintained upright, and so retained by confining the tails of the band upon the posterior aspect of the thoracic bandage. Thus applied, it will be of advantage in the treatment of burns, &c., &c., upon the front of the neck.

Again, a lateral flexion may be given to the head, as is seen in the annexed figure, (fig. 27).

18. Professor Jörg's apparatus for the treatment of "wry-neck" consists of a pair of leather stays for the chest, and of a band or strong circlet for the head. On the centre of the

Fig. 28.



stays, in front, is a ratchet-wheel, having the edge serrated in such a way as that it revolves only in one direction upon its axis, the reverse motion being prevented by a spring pressing against the teeth; a band passes upwards from the wheel to be attached to the fillet opposite the side of the head; then by turning the wheel by means of a key, *a*, the side of the head is approximated to the sternum, so as to counteract or overcome the opposing muscles of the affected side, (fig. 28).

This instrument may be employed in those cases of torticollis in which a considerable degree of force has to be exerted and continued for a length of time; where less power is requisite, the simpler bandage last-mentioned may be used.

SECTION II.

BANDAGES FOR THE TRUNK.

1. The dorso-thoracic triangle. (Mayor.)

APPLICATION.—Place the base of the triangle upon the anterior, or the posterior, aspect of the chest, as the seat of the injury may require, and tie the tails upon the thorax either before or behind, while the apex is allowed to repose over one of the shoulders, being attached to the base of the triangle through the intermedium of a band, if it be not sufficiently long of itself to reach this point.

USE.—To retain dressings upon the anterior or posterior face of the chest.

2. Circular bandage with straps, for the thorax.

COMPOSITION.—A strong towel, or an oblong piece of muslin, folded upon itself to acquire sufficient strength; and a band two feet long and four inches wide, split from one end through almost its entire length.

APPLICATION.—The napkin is wrapped around the chest, its extremities overlapping and pinned; the undivided extremity of the band is then attached in the same manner to the middle of this posteriorly, and its tails brought to the front, one over each shoulder, and pinned likewise to the same.

Instead of the split band, a triangular piece of muslin may

be used for the scapulary, by applying its base to the back of the neck, and attaching the apex to the thoracic bandage posteriorly, while the tails cross, one over each shoulder, to be pinned to the bandage in front.

Again, the thoracic band itself may be rendered more efficient, if a constant compression be desirable, by substituting straps and buckles, or by lacing it, instead of securing it by means of pins.

USE. — To confine dressings upon the thorax; to restrain the motions of the chest in wounds of this part, or in case of fracture of the ribs; and to secure, by the aid of compresses, the coaptation of the fragments, in the latter injury.

3. The compressive bandage of Velpeau, consists of a roller seven or eight yards long and three inches wide.

APPLICATION. — Let about two feet of the free end of the roller hang over the shoulder of the sound side, down the back; then carry the cylinder over the front of the chest, below the axilla of the affected side, to surround the thorax

FIG. 29.



with several circular turns, and to confine the pendant portion of the roller; ascend the chest gradually by circular folds, each one successively overlapping about two-thirds of the preceding; pass the bandage around the axillæ in the form of the figure 8, and terminate by circular folds; now, finally, raise the pendant extremity of the roller, and crossing it over the shoulder of the affected side, attach it to the inferior circular turns by pins (fig. 29).

USE: as of the preceding; it has the advantage over the ordinary circular bandages of the thorax, in being more secure, and less easily deranged.

4. The crossed bandage of the chest, or the figure 8 bandage of the shoulders.

COMPOSITION. — A roller five yards long and two and a half inches wide: cotton, or folded muslin, to protect the surface at the axillæ, and compresses if indicated.

APPLICATION. — If the object be to approximate the shoulders to the sternum, the folds of the bandage should cross in front of the chest. Place the free extremity of the roller in one of the axillæ, and pass two or three circular turns around the thorax; then, the axillæ being protected by the cotton, and the shoulders drawn towards the sternum, by an assistant, if necessary, — traverse the axillæ, say of the left side, and ascend over the shoulder from behind forwards; cross the front of the chest to the right axilla; mount over the right shoulder from its posterior to its anterior face; descend obliquely over the front of the chest

FIG. 30.



to the left axilla, whence repeat the same course as before, until four or five folds have been laid upon each shoulder, each successive fold, in approaching from the shoulder to the neck, overlapping about two-thirds of the preceding. Terminate the bandage in circular sweeps around the thorax. (Fig. 30.)

If it be desired to draw the shoulders from the breast, it can be effected by simply reversing the course of the roller, crossing the shoulders from before backwards.

USE.—To aid in the treatment of wounds of the chest, by approximating or withdrawing the shoulders from the sternum, as may be indicated by the situation of the wound; to effect pressure upon the clavicular regions, and upon the sternum, or back, or in the axillæ.

5. Suspensory for the breast.

COMPOSITION.—Double twice upon itself a piece of linen ten inches square, and from the free extremity of each folded border cut a triangular portion, of which the apex shall terminate in the fold; then open the square and sew the divided edges together; thus, a concave cap is formed adapted to the globular conformation of the breast. Attach a piece of tape, or a band of muslin, to each angle of the square.

APPLICATION.—Place the cap upon the mamma and confine it in situ by tying the two superior bands around the neck, and the inferior around the chest below the gland.

USE.—To support the mamma, and to retain dressings upon it.

6. The triangle-cap for the breast is applied, with the base passing just below the mamma, the tails knotted on the posterior part of the chest, and the apex ascending upon the gland to cross over the shoulder of the same side, and be confined to the tails, directly or through the intervention of a strip of muslin, or tape.

USE.—As of the last.

7. The compressive bandage of one breast.

It will be found exceedingly difficult, if not impossible, entirely to envelope one of the mammary glands by means of a roller, which shall be so applied as not to become deranged very soon, and yet to leave the sound breast free; but such a concurrence of conditions is frequently desirable. To fulfil these indications the following bandage may be employed.

COMPOSITION.—The same as of the suspensory of the mamma, described above, the degree of concavity of the cap being proportioned to the volume and convexity of the gland; graduated compresses.

APPLICATION.—Place the compresses upon such points of the gland as require most pressure, and cover the whole with the cap; then pass one of the superior bands over the shoulder of the sound side, and the other beneath the axilla of the side affected (the surface being protected, if necessary, by cotton interposed between the bands and the skin); knot the two: draw the inferior bands around the chest, beneath the breasts, and tie them either in front or behind. The degree of pressure exercised upon the diseased mamma can be easily regulated by the size of the compresses, and the force with which the bands shall be drawn.

USE.—To effect a regulated compression of the breast, in chronic induration or engorgement of this organ, and to obliterate the canals of sinuses, if such exist.

8. The straight jacket is a garment made of strong but light canvass, extending from the root of the neck to the upper third of the thigh. It is closed in front, and has straps and buckles attached to its posterior borders, or eyelet holes worked in them. Along its inner surface sleeves are firmly attached, throughout their entire length, open above but closed below, and at the proper distance from each other to correspond with the arms; opposite the wrists, a slit may be made through the jacket, to enable the professional attendant to feel the pulse of the patient; shoulder straps should be attached to the superior border of the canvass, to prevent the possibility of the jacket slipping down, from the efforts of the patient.

APPLICATION.—Insert the arms of the patient into the sleeves, and having nicely adapted the jacket to the body, draw its borders together behind, and confine them by the traps and buckles, or by lacing.

USE.—To assist in the restriction of the insane, or of those who are unmanageable from any cause.

A very convenient substitute for the straight jacket, and one which, while it is equally secure, is less irksome to the patient, may be found in a pair of leather mittens, made sufficiently loose to be easy to the hand, and slit at the wrist so that, after the hand is introduced, one border of the wrist-

band, in which a fenestra has been made, shall overlap the other, and be confined upon it by an iron loop, which passes through the fenestra; then insert through the loop on each wrist a leather strap, having a buckle at one end, and enclose the waist therewith.

9. The body-bandage of the abdomen consists of a piece of muslin or linen folded to an oblong shape, a foot or more in width, and long enough to envelope the abdomen; and of two narrow straps sewed to its inferior posterior margin, to serve as thigh-straps.

Application.—Place the centre of the bandage upon the median line of the loins, and bring its extremities round to the front of the abdomen, where they should be overlapped and pinned; then draw the thigh-straps to the front along the perineum, and attach them to the anterior part of the bandage.

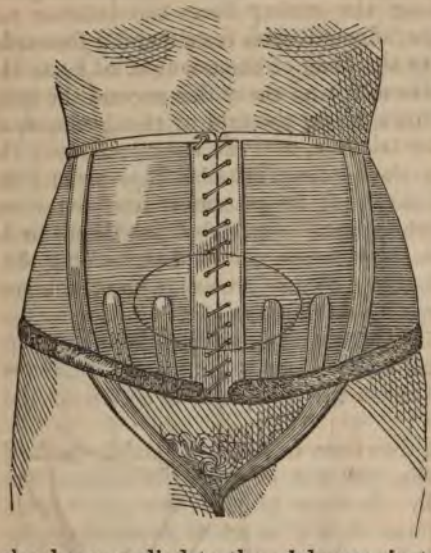
Use.—To retain surgical dressings, to give support to the walls of the abdomen, and to exercise pressure thereon, as in umbilical hernia; in the latter case a graduated compress should be employed to assist the compressive action of the bandage.

There are many cases, however, in which a bandage formed of a plain piece of muslin, will not support the walls of the abdomen sufficiently well. In order to effect this object more satisfactorily, an apparatus should be made resembling the corsets of ladies; adapted to the conformation of the belly, and rendered firm, and yet elastic, by the introduction into its folds of strips of whalebone. Its inferior margin in front should be curved, to correspond with the shape of the lower part of the abdominal parietes, so that, by being properly laced in front or behind, either a uniform pressure, diffused equally over the whole surface, can be effected, or a more partial action may be exerted in a particular direction.

An apparatus of this sort will be found applicable to many cases: in umbilical hernia, in ascites, in pregnancy, and in other instances of abdominal distension, a very agreeable support will be afforded by its use; and very considerable, if not complete, relief will be given to symptoms simulating, and sometimes, perhaps, depending upon prolapsus uteri, or other displacements of this organ; such, for example, as dragging pain and weight in the pelvis, a sense of exhaustion, of "falling-in of the belly," of faintness, &c., &c.

The annexed drawing of an apparatus of this kind is copied from Velpeau, (fig. 31).

Fig. 31.



10. The posterior pelvic triangle, of Mayor, is applied with the base along the top of the sacrum, and the apex depending over this bone: the tails are brought round to the front of the abdomen and knotted, and the apex passed between the thighs, along the perineum, and pubis, to be attached to the tails.

Use. — To retain dressings upon the sacrum and perineum.

11. The anterior pelvic triangle has the base applied to the abdomen just above the pubis, while the apex passes from before backwards between the thighs, to be attached to the tails which are tied upon the sacrum.

Use.—To confine applications to the pubis or genitals, or simply to cover these parts.

12. The triangular bandage for the groin is composed of a piece of muslin of a triangular shape, and sufficiently large to extend from the median line of the abdomen to the fold of the groin: to the base is sewed a band long enough to pass around the abdomen, and to the apex another band of about the same length.

Application.—Place the triangle upon the groin, the apex pointing downwards; tie the superior band around the waist, and bring the inferior round the thigh, from before backwards, to be pinned to the first, opposite the centre of the base of the triangle. (Fig. 32.)

Use.—To retain dressings upon the groin.

13. The cruro-inguinal triangle, of Mayor.

APPLICATION.—Dispose the base, *a*, *a*, so that it shall run obliquely from the summit of the affected groin to the edge of the iliac crest of the opposite side, the apex pointing obliquely downwards along the groin; wrap the inferior tail around the thigh of the affected side, from behind forwards, and pin its extremity to the body of the triangle, at *b*; to the superior tail attach a band, *c*, and carry this around the loins to the affected side, down along the fold of the groin, *d*, *d*, crossing the body of the triangle, and the apex,—pinning the latter to it,—around the posterior and outer aspects of the thigh, to be confined at *e*. (Fig. 33.)

USE.—As of the last.

FIG. 32.

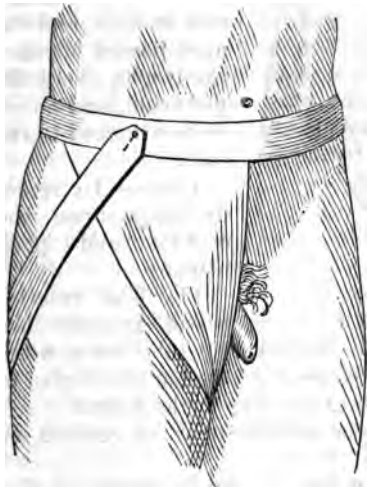
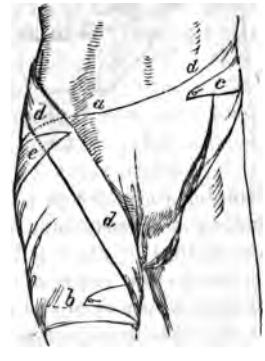


FIG. 33.



14. The spica of the groin.

APPLICATION.—Place the initial extremity of a roller seven yards long and two inches wide, upon the sound side of the pelvis, between the anterior spines of the ilium, and confine it by circular turns passing around the body, from before backwards. After having made two or three circular turns, carry the head of the roller obliquely downwards over the groin affected, around the posterior aspect of the thigh to the ilium again, then across the groin to the opposite side of the pelvis, from which it returns to the affected side and repeats the same process several times, terminating at length by one

or two circular turns. Each successive layer of the roller should leave exposed about one-third of that which preceded it; see fig. 16, *e*, *e*.

USE.—To confine dressings upon the groin, and to exercise some degree of compression upon it, as in chronic glandular enlargements and indurations.

15. The cruro-inguinal cravat, of Mayor, will be found a very good substitute for the spica just described, and much more simple in its application.

Place one end of the cravat upon the affected groin, over a compress, or not, and conduct the remainder downwards, along the groin, to pass between the genitals and the thigh, and thus gain the posterior face of the limb; ascend obliquely upwards and outwards over the thigh, cross the affected groin, and the end of the cravat already spoken of, to the iliac crest of the opposite side; wind around the loins to the ilium of the affected side, pass obliquely downwards along the groin, and gain the external face of the thigh, as before, where the extremity is to be pinned.

16. The spica for both groins.

APPLICATION.—Place the initial end of a roller, ten yards long and two inches wide, upon the pelvis, as in the single spica, and confine it by circular turns running around the pelvis from right to left, (this being the most convenient course in practice); having reached the left side, descend along the outer face of the thigh, around it posteriorly, and so gain the groin; then carry the roller upwards over the groin to the ilium of the same side, and thence around the loins to the opposite groin; descending this obliquely, pass the bandage between the genitals and the thigh, and around the limb to mount over its outer face; cross the right groin, and the lower part of the abdomen to the left ilium, and then wind around the left groin, and so proceed as before. After several turns have been made in this manner, terminate the bandage by a few circulars around the pelvis.

USE.—To effect pressure upon both groins.

The same object may be attained by the use of cravats.

17. The double T bandage of the pelvis is prepared from a band two or three yards long and three inches wide, having sewed to it at right angles, and at a convenient distance from one extremity, two other strips, distant from each

ones about two inches, each being an inch wide and half a yard long.

APPLICATION.—Place the horizontal band so that the vertical strips shall depend, one on each side of the median line of the sacrum. Confine the first by two or three circular turns around the body, and draw the vertical bands forwards between the thighs, crossing them upon the perineum, to be attached to the horizontal strip in front.

USE.—To retain applications made to the anus, vagina, or perineum.

Instead of two vertical pieces, a single strip may be used, half a yard long and as wide as both the others combined, slit at its free extremity to near the horizontal portion.

18. The suspensory of the scrotum may be made of two pieces of linen or muslin, or of network, of a size varying according to the volume of the scrotum. In general, they should be each "six inches long and four wide; the pieces being laid together with exactness, two portions are cut out curvilinearly, as shown in the wood cut (fig. 34), by dotted lines; the divided edges from *a* to *b* being sewed together, a sort of bag is formed, which presents at the middle of its upper part an opening, *f* (fig. 35), through which the penis passes. A belt, *c*, two inches wide and rather longer than is requisite to encircle the body twice, is then sewed along the upper edges of the bag, as from *c* to *d* (fig. 34); to the superior border of this belt, at about two inches each way from the centre, are attached two small loops of tape or riband, *d*, *d*, fig. 35, and about as far again from the centre two mould-buttons, *e*, *e*.

FIG. 34.

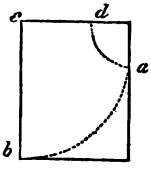
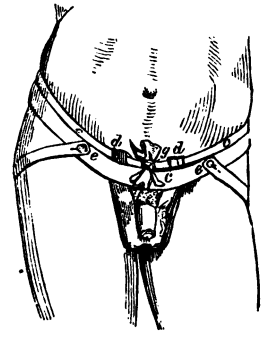


FIG. 35.



"Two bandelettes are next fastened to the lower angle of the bag, each about half a yard long, with two button-holes near their free extremities.

"APPLICATION. The penis being engaged in the triangular

opening, *f*, of the bag, and the scrotum perfectly enveloped. the belt is carried round the pelvis, and being returned through the loops, *d*, *d*, is tied above the pubis; the two bandelettes are then passed between the thighs, to ascend from the perineum along the inferior borders of the glutei muscles, and buttoned to the belt in front, *e*, *e*.

"USE.—To support and confine dressings upon the scrotum; to serve also as points of attachment for other apparatus. It is chiefly employed in the treatment of swelled testicle, hydrocele, and irreducible scrotal hernia." (Cutler, pp. 101–2.)

19. The suspensory triangle of Mayor.

APPLICATION.—Pass a cravat around the abdomen and pelvis, and knot it securely. Apply the base of a triangle to the under part of the scrotum at its origin, and draw the tails upwards in front of the cravat, to be reflected over its superior edge, between it and the abdomen, and tied as represented in the annexed figure (fig. 36). Carry the apex of the triangle upwards, inserting it behind the transverse portion of the tails (see fig. 36), between the abdomen and the girdle, to be reflected forwards over the superior border of the latter and pinned to it.

FIG. 36.



USE.—The same as of the last.

20. Bandage for the penis.

It is requisite sometimes to make use of some means for confining applications upon the penis. For this purpose a sheath is the most convenient covering. When, however, a certain degree of compression is wished for, the organ should be enveloped in circular and reversed turns of a piece of tape, or some very narrow strip prepared at the time.

For the compressive bandage of the scrotum, see remarks in the section on "adhesive plaster."

SECTION III.

BANDAGES FOR THE UPPER EXTREMITIES.

1. The axillo-clavicular cravat, of Mayor.

APPLICATION.—Place the centre of the cravat upon the axilla, and draw the tails obliquely upwards over the chest, one in front and the other behind, to be knotted together upon the clavicle of the opposite side.

USE.—To confine dressings in the axilla.

This may be varied a little, and still fulfil the same end, by crossing the tails of the cravat upon the shoulder of the affected side,—the centre being in the axilla, as before,—and then conducting them, one in front of and the other behind the chest, to the axilla of the sound side, where they are to be secured.

2. The compound bis-axillary cravat is applied, by arranging one cravat in the manner first pointed out above; and then placing the centre of a second in the other axilla, its tails being conducted obliquely upwards, one before and the other behind the chest, to be attached to the tails of the first at their point of junction.

USE.—To retain dressings in both axillæ at once.

3. The crossed bandage of the shoulder and axilla.

COMPOSITION.—A roller eight yards long and two inches wide.

APPLICATION.—Confine the initial extremity of the roller to the arm of the affected side, by a few circular turns passing from before backwards and from without inwards. Then carry the roller obliquely upwards over the shoulder of the same side, and downwards obliquely over the front of the chest to the opposite axilla. From this point, the roller should cross the back obliquely upwards to the shoulder of the affected side, and, traversing the descending turn, regain the arm from which it started. Several crosses may be made in the same manner, and the roller terminated by circular sweeps around the arm.

USE.—To confine applications made to the shoulder, or to the axilla,—or to exercise pressure upon these parts, which may be aided by the employment of compresses.

4. For the crossed bandage of both shoulders and axillæ, see Section II.

5. A sling for the fore-arm.

Place the middle of a triangle beneath the fore-arm, with the apex towards the elbow; then carry the extremities obliquely upwards, the anterior over the shoulder of the sound side, and the posterior over that of the affected side, and tie them around the neck.

To suspend the hand and wrist, an oblong piece of linen, or muslin, or a cravat, may be employed, and the part placed upon its centre; then tie the lateral portions together, leaving the hand loosely confined, and suspend the whole to some convenient part of the patient's dress, or to the neck.

6. The carpo-digito-dorsal triangle, of Mayor.

Application.—Place the triangle upon the back of the hand, its base being upon the wrist, around which the tails are to be wrapped and confined; then, having flexed the fingers to the proper degree, draw the apex of the triangle over them and attach it to the envelope of the wrist.

Use.—To approximate the edges of wounds in the palm of the hand, or on the palmar surface of the fingers; also to prevent the deformities which are likely to occur from the cicatrization of burns on the dorsal aspect of the hand.

7. The palmo-digito-brachial triangle.

Application.—Tie a band around the arm, just above the condyles of the humerus; then place a triangle upon the palmar surface of the hand, its base overlaying the wrist, around which the tails are wrapped and confined,—and reflect the apex over the fingers and back of the hand, to be attached to the extremity of the supra-condyloid band.

Use. — In transverse wounds of the dorsal aspect of the hand and fingers, and in burns of their palmar face.

8. The spiral bandage of the upper extremity is effected by the use of a roller, eight yards long and two and a half inches wide: compresses if required.

Application. — Confine the initial extremity of the roller upon the wrist by circular turns passing from the radial towards the ulnar side, — the hand being supine; traverse the palm and the back of the hand obliquely to gain the ends of the fingers, and then return to the frænum of the thumb by simple spiral turns: envelope the ball of the thumb and the

wrist by folds in the form of a figure 8, and ascend the fore-arm by spiral and reversed sweeps around the part. Having reached the elbow, place the arm in the proper position; if straight, continue the spiral and reversed turns to the shoulder: if flexed, cover the elbow with crossed folds in the form of the figure 8, and then ascend as before.

Use. — To envelope the arm, and to make uniform, or graduated, compression upon it. Great care is necessary, especially in case of injury, to avoid exercising too much pressure upon the member, as serious inconveniences and accidents have resulted from inattention in this respect.

9. The spica bandage of the upper part of the arm and the shoulder.

Composition. — A roller, eight yards long and two and a half inches wide, with compresses for the axilla of the affected side.

Application.—The right arm being the one which requires the bandage, place the roller upon the upper part of the arm, so that about two feet of its free portion shall depend from the outer side of the member; confine it in this position by one or two spiral and reversed turns, passing around the limb from its outer towards its inner face; then carry the roller up over the outer aspect of the shoulder, to descend obliquely across the chest, in front, to the axilla of the sound side, and return to the affected shoulder along the back of the chest: descend into the axilla along the front of the shoulder, and then mount over its posterior face to traverse the front of the chest, as before; having thus laid several folds, secure the terminal end of the

Fig. 37.



roller by a pin; now bring the initial portion of the bandage, which was left depending from the posterior face of the arm, to the front, over the anterior fold of the axilla and the shoulder, and around the back of the neck, to terminate in front of the chest, on the sound side, (fig. 37.)

USE. — To exercise compressing force around the upper part of the arm and shoulder.

10. The spica bandage of the thumb.

COMPOSITION. — A roller three yards long and one inch wide.

APPLICATION. — Confine the initial extremity to the wrist by circular turns passing from the radial to the ulnar margin, the hand being held in a vertical position with the thumb above; now carry the roller from the palmar towards the dorsal aspect of the thumb, between it and the index finger, sweep around the base of the former and the wrist to regain the palmar surface of the thumb; repeat this process until the roller is exhausted, and then confine its terminal end.

USE.—To compress the thumb and to restrain its motions, as after dislocation.

A spica bandage may be applied around any of the fingers, after the same manner.

11. The gauntlet.

COMPOSITION.—A roller eight yards long and an inch wide.

APPLICATION. — Confine the initial extremity to the wrist by a few circular turns, then descend to the tip of each finger, successively, by oblique sweeps of the roller, returning in spiral and reversed turns to the metacarpo-phalangeal articulation: terminate the bandage by circulars around the body of the hand and the wrist. (Fig. 38.)

USE.—To prevent the opposed surfaces of the fingers from uniting in the cicatrization of burns; to make general compression upon the hand, and to assist in the cure of fractures and dislocations of its bone

12. The demi-gauntlet.

COMPOSITION.—A roller five yards long and one inch wide.

APPLICATION. — The hand being prone, confine the initial extremity of the bandage about the wrist by circular turns passing from its ulnar to its radial side; then discontinuing the circular at the cubital side, carry the roller obliquely across the back of the hand to the radial margin of the

index finger at the junction of the phalanx with the metacarpus, across the palmar face to the cubital margin, and thence around to the radial border of the hand; cross the

Fig. 38.

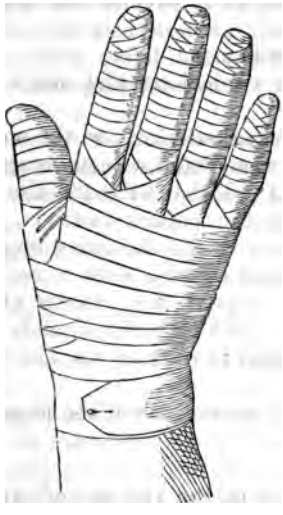


Fig. 39.



palm to its cubital side, over the back of the hand to the index side of the middle finger, around the base of this to its cubital aspect and then to the radial border of the hand; so continuing until the root of each finger is covered; terminate the bandage by a circular sweep around the wrist. (Fig. 39.)

Use.—A light retaining bandage for the back of the hand.

13. The triangle cap for the hand.

Application. — Lay the hand upon the triangle, the base overlapping the wrist; reflect the apex over the extremities of the fingers upon the wrist, and secure it in this position by wrapping the tails of the triangle around the same part.

Use.—To retain applications upon the hand, which it effects very perfectly and readily.

14. The cravat bandage for the palm or back of the hand.

Application.—Place the palm, or the back of the hand, upon the centre of the cravat; reflect the tails upon the

other surface, and cross them; after which, tie them about the wrist.

USE.—An effectual and convenient retaining bandage for the body of the hand.

15. The perforated bandage of the hand is made of a piece of muslin or linen large enough to envelope the hand, having attached to its lower margin a band half a yard or more in length, and an inch wide, and being perforated near its superior border by holes corresponding with the fingers.

APPLICATION.—Insert the fingers through their respective fenestræ, and draw the piece over the hand, enveloping the latter neatly and accurately; secure it thus by the band.

USE.—Same as of the preceding.

SECTION IV.

BANDAGES FOR THE LOWER EXTREMITY.

1. The cruro-iliac triangle, of Mayor.

COMPOSITION.—A cravat, and a triangle.

APPLICATION.—Knot the cravat around the pelvis, passing it just below the crest of the ilium; place the centre of the base of the triangle immediately beneath the great trochanter, encompass the thigh with the tails of the bandage, and tie their extremities, or confine them with pins; then raise the apex of the triangle, and inserting it between the surface of the body and the cravat which girdles the pelvis, reflect it back upon the body of the triangle and pin it.

USE.—To confine applications made upon the gluteal region.

2. The bandage of Scultetus is described fully in Sect. II. Chap. I.

3. The eighteen-tailed bandage for the lower extremity.

COMPOSITION.—Stitch transversely to a band of muslin, of sufficient length, and about four inches wide, eighteen other strips, three or four inches in width, and long enough to make one circuit and a half about the limb;—the centre of each transverse band crossing the vertical, and the individual pieces arranged in the same manner as the strips of the bandage of Scultetus, which it resembles in its application and uses; as before stated, it has the disadvantage of requiring

the removal of the whole, if a single portion of the bandage become deranged or unfit for longer employment; hence it is but little used, the other being preferred.

4. Invaginated bandages for longitudinal and transverse wounds of the thigh. For a description of the composition of these, consult Sect. II. Chap. I. Their application will be illustrated in the chapter on wounds.

5. The crossed bandage of the knee.

Composition.—A roller four yards long and two and a half inches wide.

Application.—Confine the initial extremity upon the thigh, just above the knee, by circular turns sweeping around the limb from left to right (of the dresser); then conduct the roller obliquely across the top of the knee to the posterior aspect of the leg, around which a circular turn is effected, and the roller made to ascend diagonally over the knee, crossing the first oblique: having reached the lower part of the thigh, a circular turn is made, after which the oblique and circular folds alternate with each other in the manner described, and the bandage terminates in a circular turn below or above the knee.

Use.—To exercise compression upon the knee, or to retain dressings in this situation. The same object may be attained in the popliteal region, by crossing the bandage behind, instead of in front.

It will readily be seen that a triangle, or a cravat, will fulfil the same purpose; the former as a retaining, the latter as a compressing bandage, when only a moderate degree of force is called for.

6. Weiss's elastic knee-cap, made of some elastic web, and lined with India-rubber cloth, or having strips of India rubber inserted between its layers, gives a very agreeable and sufficiently compressive support to the knee: it is confined about the joint by lacing.

As a substitute for this, the elastic bandage made of woollen yarn knit, — described with the laced bandage, in the second section of the first chapter,—may be employed.

7. The spiral bandage of the lower extremity.

Composition.—A roller six yards long and two and a half inches wide.

Application.—This may be accomplished in several ways.

1st. Confine the initial extremity of the roller around the ankle, say of the right leg, by circular turns revolving from its outer to its inner side: having reached, in the second circular turn, the external malleolus, conduct the roller across the instep obliquely to the inner side of the foot, and beneath the sole to the little toe; then retrace the course, covering the foot with two or more spiral turns; having regained the instep, ascend it obliquely and sweep around the leg from the inner to the outer side; thence cross obliquely to the inner margin of the instep, wind beneath the sole and the outer side of the foot, in advance of the malleolus, mount over the instep to the tibial side of the leg, and then conduct the roller to the knee in spiral and reversed turns. If the limb be straight, continue the same with a fresh roller, if necessary, until the whole limb shall be covered. If, however, the knee be flexed, the joint must be enveloped with folds in the form of the figure 8, and circular if need be; then ascend the thigh as in the other case (fig. 16, *d*).

This mode of bandaging the limb is very simple and secure; the only objection to it is that it leaves the heel uncovered; and as this part sometimes swells and becomes painful if left exposed while the parts above are protected, it behooves the dresser to avoid this difficulty, as in the following mode:

2d. The right leg being selected, confine the initial extremity of the roller as above; then, instead of crossing the instep, wind around the inner malleolus, and over the ridge of the tendo Achillis just above its attachment to the heel, over the space between the external malleolus and the extremity of the heel, and then cross the sole of the foot by a single oblique sweep, to the great toe; cover the foot from the toes to the instep by spiral turns, and then wind around the inner side of the heel, crossing the space between the inner malleolus and the point of the calcaneum, over the arch of the tendo Achillis to the outer side of the leg, just

Fig. 40.



above the malleolus; now pass over the instep and the point of the heel to the instep again, and wind the roller in the form of the figure 8, around the leg, the instep, and the sole, when, having conducted the bandage to the tibial margin of the leg, ascend the limb by spiral and reversed turns (fig. 40).

3d. The French spiral, as it is termed, differs but little from the first. It is usually commenced by merely placing the initial extremity upon the outer margin of the instep (but this is less secure than if it is confined around the ankle); now wind obliquely around the foot to the great toe, and beneath the sole to the opposite side; from this point cover the foot with spiral and reversed turns, extending as high up on the instep as may be consistent with the firmness of the bandage, and ascend the leg at once, in spiral and reversed sweeps, without enveloping the heel.

USE.—To restrain the action of the muscles of the leg; to compress the limb uniformly, and to assist in procuring the removal of indolent swelling of the soft parts, whether caused by serous infiltration, chronic inflammation, or otherwise.

8. Baynton's bandage for the treatment of ulcers.

This mode of treatment has been already described in the first part of the book, in the course of the remarks on Adhesive Plaster. For an illustration of its application, see fig. 40.

9. The laced stocking is made of buckskin, or of some elastic web. It is formed of two pieces fitted to the shape of the limb and sewed together along the back of the leg and the sole of the foot: the anterior margins are provided with eyelet holes, for the purpose of lacing the stocking when applied; and in order to obviate the inconveniences which might arise from the direct contact of the lacing apparatus with the skin, a piece of some soft material should be sewed along the inner surface of one of these anterior borders.

USE.—To exert a uniform and equable pressure around the leg, particularly in case of varicose veins.

10. An elastic gaiter for the foot and ankle may be very well made of India-rubber cloth, lined with linen or silk, so contrived as to correspond with the shape of the part, and still be elastic: it should be confined upon the foot by lacing along the outer side.

USE.—To support the foot and ankle after sprains of the part, or in chronic intumescence from any cause.

PART III.

BANDAGES AND APPARATUS EMPLOYED IN THE TREATMENT OF FRACTURES.

CHAPTER I.

GENERAL CONSIDERATIONS ON THE TREATMENT OF FRACTURES.

The method by which nature effects the cure of a fracture is, the formation of what is technically called "The Callus;" the different steps of this process are thus briefly stated by Müller, (Physiol., vol. i. p. 454):—"The inflammation which ensues immediately after the fracture of a bone affects principally the surrounding soft parts, viz., the periosteum, cellular tissue, and muscles, which all become enlarged and agglutinated together, so as to form a firm capsule around the fracture. On the inner surface of this capsule there is formed, as a result of the inflammation, a semi-fluid substance which gradually acquires more consistence and becomes traversed by vessels. A similar substance is effused by the medullary tissue of the broken bone; and this, together with the substance poured out by the capsule, at length coalesces, and forms the mass enclosed in the capsule and investing the ends of the bone, to which the name of 'substantia intermedia' has been given. This substance acquires a fibrous texture, and fills all the space between the bones; while the muscles, cellular tissue, and periosteum return to their former normal condition. The inflammation does not affect the bone so soon as it does the soft parts; it commences in it at some little distance from the fractured extremities, namely, at the part where the bone is still invested with periosteum, and at the corresponding point in the interior. The bone likewise now pours out a gelatinous exudation, in which vessels become developed, and

which continues to grow; while, on the side by which it is connected with the bone, it becomes converted into cartilage and bone. This new mass—the proper callus,—also occupies to a greater or less extent the medullary cavity. On the exterior, its formation is continued towards the fractured extremities, till the exudations of the two portions of bone meet and unite. Thus is formed the primitive callus.

"In the meantime, the surface of the bone unites with the capsule formed by the soft parts and the primitive callus, and the margins of the fracture unite with the 'substantia intermedia.' Callus, too, is formed, and developes itself at the expense of the now ligamentous 'substantia intermedia.' Periosteum is formed anew on the external uneven surface of the callus.

"The further changes which the callus undergoes after the ends of the bone have united, consist in the restoration of the medullary cavity in its substance, and in the change of its form. The texture of the callus undergoes the same changes as the cartilage of bone in ossification. While it is cartilaginous, it contains the peculiar corpuscles of cartilage; when it ossifies, it assumes the cellular texture of bone."

According to Dupuytren, the period during which the provisional callus is being formed, continues until the thirtieth or fortieth day. In the subsequent period, the ossification of the cartilaginous intersubstance—"substantia intermedia"—takes place not before the fourth or sixth month; the swelling of the soft parts having been first removed by absorption, the bony mass filling up the medullary canal is likewise absorbed, and this cavity restored at the end of six to twelve months.

According to the observations of Mr. Paget, the provisional callus rarely exists in the human subject, excepting in the case of those bones which cannot be kept at rest, as the ribs; while it is of common occurrence in the inferior animals. (Paget's Lectures on Surgical Pathology, vol. 1.)

Now, the aim of the surgeon, in the treatment of fractures, should be to place and preserve the injured parts in such circumstances as shall most conduce to the accomplishment of the reparative processes just mentioned. To effect this, three steps are necessary:

1st. To secure the proper apposition of the fragments, if,

as is generally the case, the broken ends have suffered displacement;

2d. To retain the fragments in this position;

3d. To prevent or remedy any unpleasant symptoms attending or following the fracture.

The method by which these indications may be best fulfilled claims a brief consideration.

1. The reduction of the fracture is effected by extension and counter-extension, the first acting upon the inferior or distal fragment, the last on the superior or proximal.

There is some diversity of opinion respecting the point from which the fragments should be operated upon: surgeons of the French school applying the extending force to that portion of the limb which articulates with the inferior fragment, and the counter-extension to that with which the superior is connected; while the English make the extending force upon the lower fragment itself, and the counter-extending upon the upper.

To each of these plans there are objections and disadvantages attached, if exclusively insisted upon. The argument urged by the Continental surgeons against the latter, viz., that by grasping the muscles which are connected with the fragments themselves, the reduction is rendered more difficult and more painful, because the muscles are made to counteract more vigorously the reducing forces,—is not really of much weight. For the efforts made to reduce a fracture need never be violent; the force operates gradually, and is exerted mediately or immediately by the hands; and, moreover, the muscular contraction with which the surgeon has to contend is induced, probably, by the irritation inflicted upon the muscular fibres as the irregular and sharp extremities of the fractured bone glide over them, during the action of the extending and counter-extending forces, rather than by the mere grasping of the muscles by the hands; and it will, therefore, be excited, whether the forces act upon the broken bone, or upon portions of the limb more distant from the seat of injury. If the French mode of reduction be practised, the surgeon is obliged to overcome the contractile force, not only of the muscles directly connected with the broken bone, but of those likewise which have their attachments to the more distant parts through which he operates.

In reducing a fracture, the surgeon may, therefore, consult his convenience as to which mode he shall adopt; if the thigh has been broken, it will be most conveniently reduced by acting upon the pelvis, and the ankle and leg just above the ankle; if the fore-arm is the seat of fracture, the injury may most easily be remedied, and with least assistance of attendants, by placing this member upon a proper splint, and operating upon the elbow and wrist, the surgeon himself making both extension and counter-extension, while the splint, with the fore-arm resting upon it, is supported by his knee, or by an attendant.

The amount of force employed in the reduction must be adapted, of course, to the resistance to be overcome; it should be gradually and steadily exerted. Much assistance will be derived from so arranging the position of the limb as that the most powerful muscles — those whose contraction is most opposed to the proper restoration of the fragments,— shall be shortened, and thus rendered in a measure quiescent: *i. e.*, the limb should be more or less flexed; and after the reduction of the fracture has been effected, this flexed position may be maintained, or the limb may be slowly and cautiously straightened, as the views of the surgeon, with regard to the permanent position of the limb during the treatment, shall dictate. The irritability of the muscles may be lessened by the administration of opium, and by distracting the patient's attention from his injury, while the reduction is being effected.

The extending force should be made in the direction which the limb has assumed since the fracture; and then, as the proper line is gradually regained, the traction should coincide with it.

As soon as the natural length of the limb has been re stored, the surgeon should adjust the fragments as accurately as possible. To this step the term "coaptation" is commonly applied. It is accomplished by pressing gently all around the neighbourhood of the seat of fracture, avoiding, as far as may be practicable, all pressure directly over and upon the fragments, in order not to give pain, and that the soft parts immediately in contact with the splintered ends of the bone shall not be wounded and irritated, more than may be unavoidable. The points of the fingers should not be used,

therefore, but the hand should be laid flatly upon the part, and very gentle pressure be gradually made from side to side.

2. The fracture having been thus reduced, the aim of the surgeon is to maintain the fragments in apposition, until consolidation shall have become perfected, or, in other words, to preserve these parts in a state of perfect rest. This can be accomplished only by mechanical appliances which shall prevent displacement of the fragments arising either from simple muscular contractions, or from external causes, or both. There are some exceptional cases from time to time occurring, in which,—from the fracture being perfectly transverse, and unattended by displacement of the fragments,—it may not be absolutely *necessary* to confine the injured part; but even in such cases, no prudent surgeon would neglect to do so, in order to guard against accident or violence.

The mechanical means of retention employed in the treatment of fractures consist, of bandages, compresses of various forms and sizes, and splints. These will be more particularly enumerated and described, when special fractures are treated of.

The operation of these means of reduction and retention will be much aided by a proper position of the limb which is the seat of the fracture,—that position, namely, which will relax the most powerful muscles, connected with either fragment. The question of position will be more particularly referred to in the section on the treatment of fractures of the thigh, to which it has more especial reference.

There are some exclusive plans of treating fractures which merit description: these are chiefly,—1st. The treatment by the "immovable apparatus;" and 2d. The hyponarthecic method of Sauter and Mayor.

The first—or the method of treatment by the "immovable apparatus,"—seems to have been introduced into France from Spain, under the auspices of the celebrated Baron Larrey. As employed by this surgeon, the mode of its application was to surround the limb—the fracture having been reduced, and the limb placed in the straight position,—by compresses, of suitable form and dimensions, saturated with a mixture of white of egg, comphorated alcohol and subacetate of lead, and retained upon the limb by folds of the bandage of Scultetus, likewise saturated with the same mixture; the

member was kept completely quiescent until the bandage had become perfectly stiff and firm, forming a rigid case around the limb. (Vidal de Cassis, Trait. de Pathol. Ext. vol. ii. 237, &c.)

Since the time of Larrey, several modifications of this method of treatment have been originated, and adopted in practice.

M. Seutin, of Belgium, employs the following apparatus: it consists of strips of muslin arranged as in the bandage of Scultetus; compresses of old linen, or of lint, and pieces of pasteboard softened in boiling water so as to be moulded to the limb. In applying this dressing, the fracture is reduced, the limb restored, as nearly as possible, to its natural shape, and then covered with folds of the bandage of Scultetus, or of the simple roller; upon this a layer of freshly prepared starch is applied by the hand, or by means of a brush; then, having filled up the irregularities upon the surface with suitable compresses, the whole is enveloped in several layers of the bandage of Scultetus, or of the roller, thoroughly impregnated with the paste; for the sake of cleanliness the last envelope should be applied dry.

If there be a wound of the integuments, or if the fracture be compound, M. Seutin directs that an aperture, corresponding in situation with the wound, should be made in the bandage, or that the various dressings should not be applied upon this point.

During the thirty-six or forty-eight hours required for the hardening of this case, the limb should be retained motionless in some secure apparatus.

At the expiration of from two to four days, M. Seutin directs that a slit should be made running longitudinally through the entire thickness of the envelope, so as to permit of the inspection of the limb; if its condition be favourable, the case is closed again by applying an additional layer or two of the starched bandage; if the parts be too much compressed, throughout, a longitudinal section is made and a strip removed; or if there be too much pressure upon any point merely, only portions of the case are cut away at corresponding points; after which the apparatus is again secured as before. In this way, during the whole duration of the

treatment, the limb should be inspected from time to time, and any difficulty remedied.

As soon as the dressing has become perfectly solid, M. Seutin allows the patient—the lower extremity being the seat of fracture — to walk about upon crutches, the broken limb supported from contact with the ground by a sling attaching it to the neck.

M. Velpeau advocates a plan somewhat different from M. Seutin's. The solidifying material which he employs consists of one hundred parts of dextrine beaten up with sixty parts of camphorated alcohol, to which is added forty parts of hot water, and the mixture is then shaken; in two minutes the solution is ready for use. Having reduced the fracture, M. Velpeau applies a dry roller around the limb, and, after filling up the inequalities of the surface by compresses, follows it by a roller saturated with the above solution; sometimes he uses also pasteboard splints properly softened and moulded to the limb, or, if these be not employed, he applies in succession a sufficient number of bandages, previously saturated, to afford firm support and protection. The limb is kept at rest until the dextrine shall have become dry.

M. Velpeau makes use of this dressing immediately after the occurrence of the injury, notwithstanding the existence of swelling and inflammation, considering that the compression which the bandage exercises upon the tissues, and the perfect immobility in which they are preserved, hasten very much the removal of this condition. He treats in this way comminuted and compound fractures, in the latter cases leaving the wound uncovered by the bandage. Unless some symptom occur to demand the removal of the dressing, M. Velpeau does not disturb it until the fracture has become consolidated.

M. Laugier employs strong paper instead of muslin, to envelope the limb. He cuts this paper into strips arranged as in the bandage of Scultetus, and having saturated them with the agglutinating mixture, covers the limb, including the foot, — if the leg be broken, — forming thus a firm and unyielding boot. This plan is resorted to immediately, and the limb inspected from time to time, as symptoms call for it, in which event the apparatus should be adjusted accordingly.

The "Immovable Apparatus" may be very advantageously

and safely used in the treatment of fractures, — particularly of the upper extremity, and of the leg,—after the injury has been treated in the ordinary way, for a sufficient time to have allowed of the cessation of liability to displacement of the fragments; in other words, when some degree of firmness has taken place. And it offers this great advantage over all other plans of treatment, that the individual upon whom it is applied may be permitted to walk freely with the aid of crutches,—exercising a reasonable caution, of course,—even with a broken leg. There are many persons who, from bad health, or from the pressing requirements of business, will not bear the long confinement to bed which the ordinary modes of treating a fracture of the lower extremity require: to such this plan is very happily adapted, suitable care being impressed upon them.

If this method is resorted to from the first occurrence of the fracture, the limb should be carefully inspected daily, and at short intervals should be exposed, particularly until it has become quite stiff, otherwise an irremediable degree of deformity may have occurred unsuspected by the surgeon, or other accidents equally, or even more, serious.

Another variety of the immovable apparatus has been recommended by M. Dieffenbach, of Berlin. It is made of plaster, poured when fluid upon the part, which has been previously denuded of hair and smeared with oil. The case is made in several pieces, according to the shape of the limb, and when it has become solidified it forms a very unyielding envelope. It presents the same advantages and disadvantages as the methods already alluded to, and is much less frequently employed than the others. (For an account of the mode in which it is prepared and applied, the reader is referred to Vidal de Cassis, op. cit., vol. ii. p. 240.—Paris, 1846.)

The second plan of treating fractures, to which allusion has been made, is that to which the term "*Hyponarthecia*" has been applied by M. Mayor, of Lausanne. This method was first recommended by M. Sauter, but afterwards more fully developed by M. Mayor. The apparatus employed consists of a piece of board, somewhat wider and longer than that division of the limb which may be the seat of the fracture, and covered with a cushion of about the same dimensions. The cushion is stuffed with oat-chaff, and is of sufficient

thickness to allow at least one-third of the posterior part of the circumference of the limb to sink into it, and receive support from it. The fracture having been reduced, the limb reposing upon the cushion, if there be but little tendency to displacement of the fragments, a wide cravat-shaped bandage merely is made to embrace both the splint and the limb, opposite to the seat of the injury; if this arrangement be found insufficient to retain the fragments in apposition, extending and counter-extending cravat bands are applied to the limb below and above the fracture, and attached to corresponding extremities of the board. If the leg be broken, the extending band is made to act upon the foot and ankle and confined to a foot-board, while the counter-extension is made upon the leg just below the knee; any disposition to lateral displacement can be remedied by acting upon the fragments by means of cravats passing to the sides of the board, one operating upon the upper and the other upon the lower fragment; or a single cravat may be so applied as to act directly upon the angle of displacement, and having its "point d'appui" upon the opposite side of the board.

This apparatus may be stationary, or it may be suspended off the bed, — if the leg be broken, — by means of cords attached to the sides of the board, and allowed to vibrate gently in the air. M. Mayor has even permitted his patients to sit up in chairs, to the back of which a framework is attached arching over in front, with the apparatus suspended from it. If the arm be broken, the apparatus is suspended from the neck upon the chest, and the limb placed upon it and suitably confined by cravats.

Under the head of special fractures, this apparatus will be illustrated. (See fig. 53.)

The chief advantages which M. Mayor claims for this method of treatment are, that it leaves the fractured limb constantly open to inspection, that it is very simple in its arrangement and employment, and that it allows of a certain degree and kind of movement of the limb as a whole, without permitting the fragments of the bone to become displaced; this last proposition, however, admits of so much doubt that, in most cases, we should dissuade from the employment of M. Mayor's method, considering it to be not sufficiently secure; indeed the very fact that the apparatus, with the

limb upon it, is allowed to execute, and is even arranged for, a degree of motion, though it be practised gently and with caution, renders some displacement almost certain.

There are various accidents which are liable to occur, and many complications to be met with, in the treatment of fractures, which render necessary corresponding modifications of the methods ordinarily pursued. Such, for example, are excoriations, and sloughings of different parts of the surface; wounds; a tendency to particular varieties of displacement: these subjects will be more properly attended to in the consideration of special fractures, when the mode of obviating, or remedying, them will be pointed out. As, however, it is oftentimes necessary in cases of fracture to subdue inflammation, it will be convenient to state here that, the plan to be pursued in such circumstances is to apply leeches upon the part, if required, and to leave the surface exposed, as much as shall be consistent with the proper security of the fragments, in order that cooling lotions shall be laid upon it, or other local antiphlogistic applications.

Before proceeding to the special bandages and apparatus used in the treatment of this class of injuries, it will be proper to allude to two or three subjects of correlative interest and importance.

When an individual suffers a fracture of the lower extremity, — or meets with any injury which incapacitates him for walking, the proper mode of removing him to his home, or to the hospital, is a serious concern. Generally, it is necessary, in such cases, to make use of any means of transportation which shall chance to present itself, as a window-shutter, a door, or a settee; but every public institution for the relief of the sick should have attached to it, as an important part of its apparatus, a vehicle contrived expressly for the purpose. This may be made like the ordinary hand-barrow, having its body about seven feet long and two and a half or three feet wide, provided with a slatted or sacking-bottom, and with a mattrass and cushions, and supported off the ground upon legs, two feet, or more, in length: when used in carrying a patient, two men should be employed, one to sustain each extremity. The patient should be extended upon the mattrass, the injured part comfortably and securely reposing upon the cushions. If one of the extremities be

fractured, or otherwise hurt, the limb should be so placed as that the painful action of the muscles shall be counteracted, as much as possible, by position, and attention should be directed, temporarily at least, to any pressing emergency, — for example, to the existence of hemorrhage, excessive pain, syncope, &c.

The part which is the seat of the injury, should be exposed very gently by cutting off the clothes or other coverings which envelope it, rather than by drawing them away; the pantaloons, for instance, should be ripped along the outer seam, and the boots divided in the most convenient manner by a knife. In cleansing the surface, and in making the necessary examinations, delicacy of manipulation should be invariably studied, and the infliction of any unnecessary pain scrupulously avoided. In removing the patient from the litter, and in placing him upon the bed, the same care should be exercised, the injured part being supported by the surgeon himself.

Not the least important desideratum in the treatment of those fractures, or other injuries, which require that the patient shall lie perfectly quiescent for a considerable length of time, is a proper bed, which is rarely to be met with. The fracture-bed in general use is an ordinary mattrass firmly and smoothly filled, and having a circular aperture cut through its centre, to correspond with a similar aperture in the sacking or floor of the bedstead. When the patient is about to have an evacuation, the cushion which covers the hole in the mattrass is removed, and a suitable vessel made to slide along a double groove, placed across the bottom of the bedstead, to receive the passage. The objections to this bed are that, the patient is obliged to raise himself, or to be raised, when the cushion is withdrawn and replaced, and that after the bed has been in use for a short time, it sinks very much in the middle, so as no longer to present a flat surface to support the body and hips; both of these are serious objections and inconveniences. They may be, in a great measure at least, obviated, by employing a bed constructed after the following method: the mattrass should be very firmly and evenly filled with hair; it should be five or six inches in thickness, with the margins, or border, perpendicular, about seven feet long and from four to four and a half feet wide. An oblong sec-

tion of about eight inches in width, and extending across the middle from one side to the distance of a few inches beyond the median line, should be removed, and, after having been properly prepared, be arranged so as to be drawn backwards and forwards at pleasure upon the floor of the bedstead. The bottom of the bedstead should be made of board, and should be entire, with a movable section opposite that of the mattrass, corresponding with it in length and breadth, and so adapted as always to afford a perfectly firm support to it, which may be readily accomplished by allowing the slat to play upon a double groove. When an evacuation is to be received, one hand of the attendant should be placed underneath the hip of the patient, and the section of the bedstead and of the mattrass be withdrawn only so far as to allow the passage to take place freely, while the hip still reposes upon the edge of the section of the mattrass; the vessel for receiving the evacuation may be supported in any convenient manner underneath the bedstead. Or an aperture of suitable size to permit of the evacuation, but not unnecessarily large, may be cut in the centre of the mattrass, and the portion which was removed adapted, by a hinge joint on its inferior surface, to close the aperture when the evacuation has been accomplished, being kept closed by a movable strip passing across the bedstead and constituting part of its floor.

A very good substitute for the fracture-bed, particularly for children, will be found in the clinical frame, such as is described in the Appendix of Cutler's treatise on bandaging. It consists of a simple framework, of two longitudinal and two transverse bars attached at their extremities, about seven feet long and a yard wide; a single piece of canvass, with a circular aperture in its centre, is firmly stretched upon it, or several strips of webbing are nailed across it, intersecting each other in various directions, but leaving a sufficiently large vacant space in the middle. The frame thus prepared is habitually placed upon the mattrass, having been previously covered with a sheet in the centre of which a circular hole has been cut, and the patient reposes upon it; when he desires to have a passage, the frame is raised sufficiently off the bed, and supported in this position in any convenient and secure manner, while the evacuation is received in a proper vessel. The frame may be raised by two attendants, or by

means of the tripod arrangement of Cutler, which consists of three strong bars united by a hinge-joint at their upper extremities, and having an iron ring or hook secured to their point of union and presenting downwards: through this ring a long lever is passed, having attached to one end of it the cords by which the frame is suspended, while the force for elevating the latter is exerted upon the other extremity: when the frame is raised, the lever may be secured in position by cords attached to some fixed point.

The apparatus of Jenks, of which a description and a drawing are given in Gibson's Surgery, vol. i., is more complicated and very much more costly than the simple contrivance above described: it is, however, a much more perfect arrangement, and should be introduced into every hospital. But in private practice it is generally sufficient to trust to the fracture-bed for adults, and to the simple frame described for children, who can be lifted from the bed by mere muscular strength.

CHAPTER II.

BANDAGES AND DRESSINGS FOR FRACTURES OF THE BONES OF THE HEAD AND TRUNK.

SECTION I.

FOR FRACTURES OF THE BONES OF THE SKULL AND FACE.

1. When, in fractures of the cranial bones there is displacement of the fragments, it is produced by the violence, whatever this may have been, which occasioned the solution of continuity, and not, as in similar injuries of the long bones, by muscular action. Hence, after the displacement has been remedied,—if it be necessary, or advisable to attempt it,—bandages are only required for the purpose of protecting the injured parts from external irritation, and of retaining such dressings as may be applied; they are, therefore, very simple, as for example, strips of adhesive plaster, the triangle of Mayor, the T bandage, or an ordinary night-cap, or finally, the recurrent bandage:—these have already been described.

2. Generally, the same remarks may be extended to fractures of the facial bones, those of the nose for instance: the fragments having been restored as well as possible, to their natural positions, they need no bandages to preserve them "in situ;" the latter are serviceable only as retentive or protective means.

3. In fractures of the inferior maxillary bone, however, the fragments are almost always displaced, and retained in their abnormal situations, by the direct action of the muscles which are connected with them, as the digastric, the hyoid, the pterygoid muscles, &c., &c.; it becomes necessary, consequently, to employ some kind of bandage or apparatus which shall counteract the influence of these displacing agents.

The bandages most frequently used for this purpose, and which will probably be found sufficient in all cases,—are the

four-tailed of the chin, and those of Drs. Gibson and Barton, of this city.

1. The four-tailed bandage of the chin.

COMPOSITION.—An oblong piece of stout pasteboard divided at each end to within an inch of the middle;—a four-tailed bandage, prepared as directed in the section on bandages of the head;—compresses.

APPLICATION.—The pasteboard, previously softened by immersion in hot water and moulded to the form of the chin and jaw, (fig. 41,) is applied upon the seat of fracture; then the middle portion of the bandage is placed upon the chin, over the splint; the two superior tails, *a*, *a*, fig. 20, are carried, one on each side, towards the nape of the neck, where they are crossed, and then conducted, one along each side of the head, obliquely upwards and forwards to the forehead, and pinned; the lower tails, *b*, *b*, are now carried upwards before the ears, to the summit of the head, where they in turn are crossed, and then returned and confined beneath the chin. (Cutler, p. 70.)

FIG. 41.



2. The bandage of Professor Gibson, and its application are thus described by the author himself: "The surgeon having carefully examined the injured parts, and replaced such teeth as may have been shaken or loosened, runs his finger along the margin of the jaw, models the parts to a proper shape, and closes the mouth firmly, making the lower teeth press fairly against the upper. Then a cotton or linen compress of moderate thickness, reaching from the angle of the jaw nearly to the chin, is placed beneath and held by an assistant, while the surgeon takes a roller, four or five yards long and an inch and a half wide, and passes it by several successive turns under the jaw, up along the sides of the face and over the head; now changing the course of the bandage, he causes it to pass off at a right angle from the perpendicular cast, and to encircle the temple, occiput, and forehead horizontally by several turns; finally, to render the whole more secure, several additional horizontal turns are made around the back of the neck, under the ear, along the base of the jaw, and over the point of the chin. To prevent the roller from slipping or changing

its position, a short strip may be secured by a pin to the horizontal turn that encircles the forehead, and passed backwards along the centre of the head as far as the neck, where it must be tacked to the lower horizontal turn,—care being taken to insert pins at every point at which the roller has crossed. This simple method of securing a fractured jaw I have practiced very successfully for several years." (Fig. 42.)

3. Dr. J. R. Barton's bandage.

COMPOSITION.—A roller five yards long and two inches wide; suitable compresses.

APPLICATION.—Place the initial extremity of the roller upon the occiput just below its protuberance, and conduct the cylinder obliquely over the centre of the left parietal bone to the top of the head; thence descend across the right temple and the zygomatic arch, and pass beneath the chin to the left side

FIG. 42.



FIG. 43.



of the face; mount over the left zygoma and temple to the summit of the cranium, and regain the starting-point at the occiput by traversing obliquely the right parietal bone; next wind around the base of the lower jaw on the left side to the chin, and thence return to the occiput along the right side of the maxilla; repeat the same course, step by step, until the roller is spent, and then confine its terminal end. (Fig. 43.)

These bandages are easily applied, and are very efficacious; the pasteboard splint described in connexion with the first,

will be found to be a very useful adjunct to the two latter. The bandage may be made to act upon any particular portion of the jaw, as required by the situation of the fracture, by modifying slightly the course of the roller in its successive turns, and by a proper position of the compresses; a little reflection on the part of the dresser will enable him to adapt his means of treatment to the ends indicated in each case.

Mr. Lonsdale invented a complicated apparatus for the treatment of a particular case of fracture at the symphysis of the lower jaw, in which much difficulty was experienced. He found it to answer perfectly in this instance, and in several other cases which occurred afterwards. The ends which he had in view, and which he gained by this apparatus, were "to apply all the force and pressure to the lower jaw alone; to fix the two portions of bone between two parallel forces, by applying one on the teeth, and the other under the base of the jaw; lastly, to keep the two portions of bone on the same vertical plane, by fixing them in a grooved plate placed along the teeth." For the description and illustration of Mr. Lonsdale's apparatus, the reader is referred to this gentleman's "Practical Treatise on Fractures," p. 234, et seq.; or to Mr. Cutler's book, p. 71, et seq.

If the fracture be compound, or in a simple fracture complicated with a wound of the cheek, or chin, the folds of the bandage must be so arranged as not to press with too much force directly upon the wound, and to allow of the application of suitable dressings, of which the first object is to promote immediate closure of the wound.

SECTION II.

BANDAGES FOR FRACTURES OF THE BONES OF THE TRUNK.

1. For fractures of the vertebra.

The bones of the spinal column are very much screened and protected from fracture by their peculiar shape and situation; hence they are rarely broken. When they are thus injured, it is most frequently the spinous process which suffers, as being the most exposed, and, from its form and structure,

the most readily broken. But very little displacement follows when it is fractured, since it is imbedded in muscles and ligaments, and acted upon with equal force from both sides. A bandage is not, therefore, really needed in cases of this kind; it is very proper, however, to make use of the roller, as exhibited in fig. 29, or of the laced bandage of the chest, already described, with compresses placed upon the spinous process, in order to insure perfect apposition of the fragments, and to prevent injury from the movements of the patient in bed. The injury done to the spinal medulla is generally such as to demand more attention on the part of the surgeon than the mere fracture. The condition of the bladder, especially, will require watchfulness, retention of urine being a very common accompaniment of the accident, and demanding the introduction of the catheter at least twice daily. Sloughing of the integuments, wherever pressure falls, is also a troublesome complication, and one which should be prevented, if possible, by frictions of such parts, and by the proper adjustment of pillows.

2. For fractures of the ribs and sternum.

A little reflection upon the shape and connexions of these bones will show that there cannot, as a general rule, be much displacement of their fragments when they are broken. The ribs are attached to each other both above and below, and throughout their entire length, by the intercostal muscles; they are strongly bound to the vertebræ, and connected to the sternum in front by a very elastic tissue; while the sternum is itself securely united to the clavicles, and retained "in relief," as it were, by the numerous costal arches which subtend it on each side. Thus the whole, and each part, are so elastic that they regain their original shape, when this has been altered in case of fracture, unless the fragments are driven into the cavity of the chest by great violence.

The general indication of treatment in fractures of the ribs and sternum is to prevent, as much as practicable, the play of the thoracic respiratory muscles, devolving the performance of the mechanical acts of respiration upon the diaphragm, thereby preserving the broken bones in a state of comparative repose. To accomplish this, compresses and a bandage of some sort are necessary. The laced or buckled bandage of the chest will answer very well in many cases, but generally

the roller is to be preferred. Its application should be commenced from below, the patient having previously made a forcible expiration; the roller should ascend to the axilla by circular turns, made with considerable tightness, and then pass obliquely upwards and outwards from the axilla to the oot of the neck on the opposite side, and down in front of he chest, crossing the circular folds of the bandage which it erves to secure by means of pins inserted at intervals. The roller for this bandage should be about eight yards long and three inches wide.

The proper disposition of the compresses is a matter of much importance in the treatment of these fractures. If a rib has been broken by force acting upon its anterior portion, the solution of continuity has occurred probably near the angle, where the anterior and posterior curves meet; the first effect of the violence has been to increase the bend of the rib at this region, and finally to rupture its fibres; of course there will be an angular displacement externally, and the compress should be applied either directly over the fracture, or one should be placed a little anteriorly and another just posteriorly to it. But when the force impinges upon the angle or side of the rib, if there be any displacement appreciable, it is probably towards the cavity of the chest, and the compresses should be so placed as to restore, if possible, the natural curve of the bone, and thus to throw the fragments outwards. To effect this object, apply one compress upon the rib near its junction with its cartilage, and another near its angle, as far posteriorly as may be; or, as Mr. Lonsdale advises, a broad lath or piece of pasteboard, may be laid upon the side of the chest and confined by a roller, being made to press with especial force upon points remote from the seat of fracture.

If the sternum has been broken, and there be depression of one of the fragments, a compress should be laid upon the portion which is not depressed, near the line of fracture, and another upon the depressed portion of the bone at a point remote from the rupture, so that, when the roller is made to act forcibly upon the two, the first fragment will be depressed and the other elevated, at the broken margin.

The bandage should be worn four or five weeks.

3. For fractures of the pelvic bones. These bones are

very rarely broken, and they are so enveloped, individually and collectively, in muscular and ligamentous expansions covering their whole surfaces, that in the event of fracture there can be but slight displacement, unless when the fragments are violently forced inwards.

The indication for the treatment is, of course, to keep the fragments at rest. To accomplish this a broad roller should be passed firmly around the upper part of the thighs and the pelvis, and compresses judiciously applied to enable the bandage to act upon particular points, as may be required. Perfect quiescence should be enjoined upon the patient for a length of time, — from two to two and a half months. The state of the bladder must be carefully attended to.

In cases of compound fracture of the bones of the head and trunk, the dressings must be so applied as not to press with too much force upon parts surrounding the wound, otherwise sloughing of the integuments may ensue. The bandage should cover the wound very lightly, in order that suitable applications may be made to it: it is better indeed that the bandage for the fracture itself shall leave the wound exposed, and that an additional retentive band be employed for such dressings as may be called for.

CHAPTER III.

ON THE APPARATUS AND DRESSINGS FOR FRACTURES OF THE BONES OF THE SHOULDER.

SECTION I.

FOR FRACTURES OF THE CLAVICLE.

THE slender proportions and exposed situations of this bone render it very liable to be broken; and in the great majority of instances a considerable degree of displacement accompanies the fracture; the exceptional cases are those in which the solution of continuity has occurred at the acromial extremity of the bone, where the surface is broad and covered with ligamentous expansions. But when, as generally happens, the fracture has involved the more central portions of the clavicle, an angular deformity is produced, presenting anteriorly, the scapular fragment being dragged downwards by the weight of the arm, and drawn towards the median line of the chest, in front, by the action of the pectoral muscles; the sternal fragment is but little deviated from its natural position, being held in place by the combined but counteracting forces of the sterno-clavicular and costo-clavicular ligaments, and of the sterno-cleido-mastoid muscle; the prominence seen and felt at the point of fracture is due, in most cases to the sternal fragment, the scapular portion being drawn rather below and behind the other; sometimes, however, the scapular fragment projects in advance of the sternal. The fracture is usually oblique and simple; comminuted and compound fractures occur, however, at times.

The indication to be pursued in the treatment of this injury is, of course, to reverse the line of displacement of the scapular segment of the bone; viz., to force the shoulder, and with it the fragment of the clavicle which is attached to it, upwards, outwards, and backwards; and having thus restored

the natural form of the clavicle, to retain the parts in this position until consolidation of the fracture shall have taken place. The first, or the reduction, is not difficult; the last demands constant care from the surgeon, and a well-contrived apparatus. In regard to this, M. Vidal (de Cassis) says — "fracture of the clavicle is *almost always* followed by deformity;" and he adds very truly, "but this deformity is not attended with much inconvenience, and does not seriously impair the movements of the limb." In females particularly, however, a deformity in so exposed a situation as this, must be unpleasant, and every endeavour should be made to prevent its occurrence.

It is interesting to trace the progressive steps which have been made in the treatment of this injury. "Hippocrates considered it necessary merely to draw the shoulder outwards and backwards. With this view he directed the patient to lie upon some prominent body, the back only being supported, while the shoulders were forced backwards and outwards by their simple weight. Paulus Œgineta, in addition to this, placed a pad in the axilla. Guy de Chauliac endeavoured to fulfil the same indication by means of a bandage applied around the shoulders in the form of the figure 8, which plan was generally adopted, and of which many surgeons recommended modifications without, however, increasing its efficacy." (See Vidal de Cassis, op. cit., vol. ii. p. 291, et seq.) Thus from time to time, until the present day, many varieties of apparatus, some of them very complicated, possessing different degrees of excellence, have been contrived for the treatment of fractures of the clavicle. It was reserved, however, for one of our own countrymen, a surgeon of this city, Dr. George Fox,—to invent, in the year 1828, an apparatus which admirably fulfils every indication, is very simple in its construction and application, is more comfortably borne, perhaps, than any other, and yet leaves the injured clavicle freely and constantly exposed to the view of the surgeon, and for the application of topical remedies, if required.

The apparatus of Dr. Fox consists of a firmly stuffed pad of a wedge shape, and about half as long as the humerus, having a band attached to each extremity of its upper or thickest margin: a sling to suspend the elbow and fore-arm,

made of strong muslin, with a cord attached to the humeral extremity, and another to each end of the carpal portion; and a ring made of muslin stuffed with cotton to encircle the sound shoulder, and serve as means of acting upon and securing the sling. The apparatus is applied thus:—Pass the arm of the uninjured side through the ring, so that the latter may surround the shoulder; press the thick end of the pad firmly against the summit of the axilla of the affected side, and carry the bands which are attached to it, one in front of and the other behind the corresponding shoulder, to cross upon the root of the neck and traverse the chest obliquely, before and behind, and to be tied to the ring; then having fixed the elbow and the fore-arm corresponding with the fractured clavicle in the sling, conduct its posterior cord behind the thorax, and the two anterior cords in front of it, and secure them to the ring. The shoulder can be operated upon very powerfully by means of these cords; it can be thrown upwards, or backwards and outwards, to any required degree, and one of these motions can be impressed upon it at pleasure, until the surgeon shall be satisfied with the position of the fragments.

Soft pads of cotton should be interposed between the surface and the apparatus at different points; and, from time to time, when the surgeon re-arranges the dressings, he should endeavour to make the pressure bear upon parts of the surface which have not previously, or recently, been acted upon. The point of the elbow will require protection in this way; frequently it is well to make a circular aperture in the sling and, having covered it with a flattened mass of cotton, to allow the point of the elbow to sink into it.

If the fracture is comminuted, a compress may be placed over the fragments, to assist in the securing of perfect apposition.

Fractures of the clavicle, treated by this apparatus, are daily dismissed from the Pennsylvania Hospital, and by surgeons in private practice, cured without perceptible deformity; and no one who has employed it will be disposed to use any other as a substitute.

The annexed drawing exhibits this dressing as applied. (Fig. 44.) A mere inspection of it will show the advantages of this apparatus over all others, in the complete performance

of the requisite revolutions of the shoulder, the exposure of the injured parts, its lightness, and the avoidance of impediment to respiration, and of pressure upon the mammary glands when it is applied to females; in each of these particulars the complicated bandage of Dessault, which is still used by some surgeons, is open to serious objection; the same remark is likewise applicable to the plan of treatment recommended and illustrated by M. Velpeau (op. cit., vol. i. p. 229); indeed this must be less efficacious than the other, since it merely confines, by means of a roller, the hand corresponding with the broken clavicle upon the sound shoulder, no pad being placed in the axilla to force the scapular fragment outwards. (See fig. 46.)

Fig. 44.

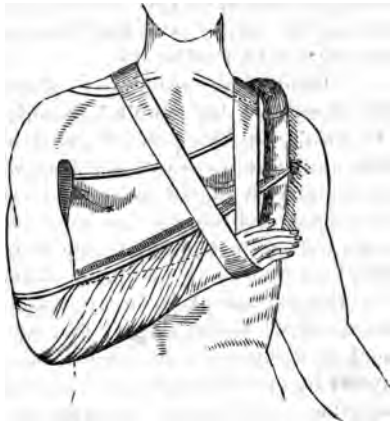
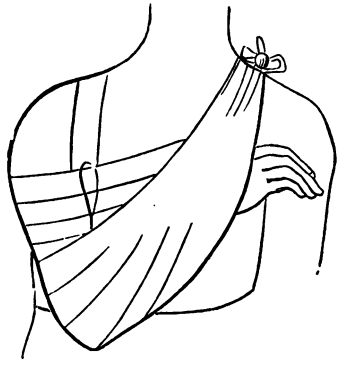


Fig. 45.



As a temporary bandage, to be employed during the short time necessary for the preparation of Fox's apparatus, if the surgeon have not one already made, that recommended by Mr. Lonsdale may be used. A pad, resembling in shape that already described, is to be secured in the axilla by means of a roller. "The elbow is next to be brought before the chest as far as possible, and to be held there, while a few turns of the roller are passed

around to confine it to the thorax; a sling is then to be applied, which must be made very short, so as to prevent the elbow from falling from the position into which it has been brought, for upon this depends the whole action of the humerus on the scapular end of the clavicle." (Lonsdale, op. cit., pp. 212, 213.) (Fig. 45.)

A bandage very similar to this was described by Dr. Brown, of New York, in the Philadelphia Medical Recorder of 1821. It requires that a pad of a wedge shape shall be confined in the axilla by means of a roller, which also fixes the fore-arm, previously flexed at an acute angle upon the breast, leaving the wrist and hand to be supported by a sling. This bandage is described in detail and illustrated by a drawing in the Medical Recorder, as above mentioned.

Many other plans of treatment have been proposed and resorted to, but the apparatus of Fox will be found of itself sufficient for all cases which may occur. Latterly, an entirely novel method has been instituted in France by M. Guillou; this gentleman reported it to the Academy of Sciences of Paris, and the description of his mode of treatment was published in full in "L'Abeille Médicale," for October, 1847; the following summary is taken from that journal:

The apparatus consists of five pieces, — 1st, of a sling made of a handkerchief of proper length; 2d, of a cravat folded in the middle; 3d, of a body-bandage formed of a towel; 4th, of a square cushion of linen, thicker in the middle than along the margin; 5th, of a pad for the axilla, having a band of about a foot and a half long attached to its base on each side.

In the adjustment of the apparatus, the pad is placed in the axilla of the injured side, and secured in this position by crossing its bands upon the sound shoulder; the forearm is then thrown behind the back and supported by the sling, which is passed around the neck, and made longer or shorter, according to the degree of force which it may be necessary to exert upon the external fragment of the clavicle, since the more the fore-arm is raised, the more the external fragment will be thrown outwards, backwards, and upwards; in order to confine the arm securely in this position, the body-bandage is applied, to compress the lower part of the humerus against the thorax, while the cravat band acts in a similar manner

upon the upper portion of the arm, being wrapped around this part of the humerus, and fastened upon the sound shoulder; to increase the power of the cravat, the square cushion is inserted between it and the back, and the cravat and the body-bandage are pinned to it.

M. Guillou has employed this method of treatment for some years, and prefers it to all others.

The author has treated several cases of fracture of the clavicle after this method, and has found it to accomplish all the indications as well as Fox's apparatus. It is, however, rather more irksome to the patient, during the first few days, than the dressing of Dr. Fox. The pieces composing the latter apparatus may be used instead of those described by M. Guillou.

The duration of treatment of cases of simple fracture of the clavicle may be stated at six or eight weeks.

SECTION II.

FOR FRACTURES OF THE SCAPULA.

Viewing merely the prominent situation of the scapula, and its rather delicate physical conformation, one would fancy that it was particularly subject to breakage; but this is not really the case. It reposes upon a soft and yielding bed of muscular tissue, and is covered by the same sort of structure, so that any force which acts upon the scapular region is deprived of a large part of its capacity to injure, before its influence has extended to the bone itself. Even its projecting processes, little adapted as they are in themselves to resist violence, are sheltered and protected in the same way.

The parts of the scapula which are most often broken are, in the order of frequency, the acromion process, the inferior angle of the bone, the body, the coracoid process, and, finally, the neck.

1. Of the body and inferior angle.

When the body of the scapula is fractured either obliquely or transversely, there cannot be much separation or displacement of the fragments, since its whole surface, both in front and posteriorly, is covered by an expansion of muscular

fibres, having an attachment around the margin of the bone. The indication to be kept in view, therefore, in the treatment of this accident, is merely to maintain the fragments at rest, by preventing the action of the muscles which operate upon them directly and indirectly. This object is readily and completely attained, by applying over the body of the scapula a broad compress, and securing it in this situation by passing a wide roller around the chest; the arm should be kept at rest in the flexed position, supported in a sling, and confined upon the breast.

When a fracture separates the inferior angle from its connexion with the body of the scapula, the former is more or less drawn away from the latter by the action of the teres major muscle. Hence, in the treatment of this fracture, the arm should be carried backwards towards the scapula, in order to relax this muscle, and confined in this position by means of a broad roller, which shall likewise press upon the body of the bone and its inferior angle,— the fragments having been put in apposition,— by the intervention of compresses placed directly upon these parts. The fore-arm should be supported by a sling.

2. Of the coracoid process.

This portion of the scapula is placed very much out of the reach of injury, yet it is occasionally broken. When fractured, a certain amount of displacement will probably occur as a result of the action of the three muscles attached to it, viz., the pectoralis minor, the coraco-brachialis, and the short head of the biceps, whose combined agency will drag the fragment downwards and somewhat inwards, towards the point of origin of the smaller pectoral muscle.

To re-adjust the fragments, the above-named muscles must be relaxed, and some small compression made over the broken process. The fore-arm should be flexed to an acute angle and supported upon the breast, the hand of the injured side resting upon the sound shoulder, while a graduated compress is confined over the natural situation of the coracoid process by means of the spica bandage (fig. 37). Or the bandage which M. Velpeau recommends for the treatment of fractures of the clavicle (op. cit., p. 229), will fulfil the same indications very well; thus: select a roller from ten to twelve yards long and two and a half inches wide, and apply its initial extremity to

the axilla of the sound side; then conduct the cylinder obliquely upwards over the back to the affected shoulder, place the hand of this side upon the opposite shoulder, the fore-arm reposing upon the chest, and continue the roller over the clavicle of the injured side, across the upper part of the arm to the outside of the same, and so under the arm, the elbow and the fore-arm to the axilla of the sound side; from this point, repeat the same course until several turns have been made in doloires opening towards the point of the shoulder. Having reached the axilla after the fourth or fifth fold, continue the roller in circular sweeps passing horizontally around the back, the axilla of the injured side, the arm, elbow and fore-arm, and thus alternate the oblique and horizontal turns until the roller is exhausted. In order to make the folds secure, insert pins at the different points of crossing, or cover the whole with the starch or dextrine solution. A

Fig. 46.



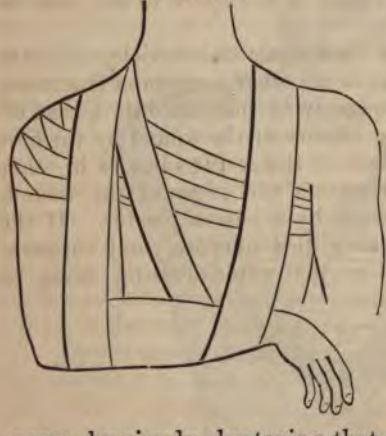
graduated compress applied upon the coracoid process, before crossing it with the roller, will adapt this bandage more perfectly to this particular fracture (fig. 46).

3. Of the acromion process and the neck of the scapula.

When the neck of the bone is separated from the body, it is drawn downwards by the weight of the arm, and the course of treatment is at once rendered manifest, viz., to apply such a dressing as shall restore the bone to its natural situation and preserve its apposition with the main fragment. A pad should be placed in the axilla against the head of the humerus and firmly supported, while the shoulder is raised and the arm maintained in repose upon the breast, with the fore-arm flexed. Fox's apparatus for fractures of the clavicle fulfils all the indications very perfectly. (See fracture of the clavicle.)

When the acromion process is broken, the weight of the arm, as in the other case, draws the fragment from its natural position, and the same kind of treatment is indicated, with the addition of a certain degree of compression upon the process itself. The apparatus of Dr. Fox is applicable to this injury, also—with a figure-8 bandage applied to act upon a compress placed upon the acromion process (see crossed bandage of shoulder and axilla); or the mode of dressing recommended by Mr. Lonsdale will fulfil the indications very elegantly. The process may be steadied by the spica bandage, which is to be applied over the shoulder and then under the axilla of the affected side, &c., &c., until the roller is nearly exhausted. The last part of the bandage may be made to cross the shoulder, to descend in front and pass under the elbow and lower part of the fore-arm, by which means any degree of pressure can be made upwards with the head of the humerus, by simply shortening that portion of the roller which

Fig. 47.



passes under the elbow. The wood-cut (fig. 47) represents this bandage applied. (Lonsdale, p. 202, 3.) It will be seen at once that, by regulating the length of the sling on which the elbow reposes, and allowing the wrist and hand to droop more, or less, as may be required in each particular case, the degree of pressure upwards against the acromion process may be much modified. This bandage of Mr. Lonsdale is open to the objection, that it does not sufficiently confine the arm.

The bandage of Velpeau, above described, will also answer very well for the treatment of this fracture. (Fig. 46.)

After fractures of the scapula, generally, the parts should be kept at rest in a secure apparatus for six or eight weeks, and when the neck of the bone is detached from the body, a longer time is required to complete the union; Sir A. Cooper fixes it at from ten to twelve weeks. But as soon as the fragments have become so far united, as that there is no perceptible motion between them, upon careful and gentle handling, passive motion should be resorted to: this is particularly important in fracture of the neck of the scapula, for, if the shoulder-joint is allowed to remain perfectly motionless during the ten or twelve weeks which are requisite for entire solidification of the fracture, the head of the humerus will be found to have become so firmly fixed in its socket, that another series of weeks will be required to restore to the joint its ease of motion.

In compound fractures of the scapula and clavicle, an object of primary importance is, as in all other compound fractures, to convert the injury as speedily as possible into a case of simple fracture, by inducing closure of the wound by the first intention. The mode of effecting this is the same as in other similar injuries: by approximating the edges of the wound, and retaining them in contact by adhesive plaster. If the surgeon fails of accomplishing this purpose, and suppuration ensues, the poultice, or the water-dressing, must be substituted.

CHAPTER IV.

ON THE APPARATUS AND DRESSINGS FOR FRACTURES OF THE BONES OF THE UPPER EXTREMITY.

SECTION I.

FOR FRACTURES OF THE HUMERUS.

It is in fractures of the long bones of the extremities, that displacements are most frequent and most varied in direction; for these bones are acted upon at different points of their surface by numerous muscles, having contractile fibres, varying in their lengths and in their directions of contraction. Hence, in a measure, the great numbers of apparatus which have been contrived for the treatment of these injuries.

The humerus may be broken in its shaft, or at the condyloid, or scapular extremity; the first is the most frequent seat of fracture.

1. Fracture at the *shaft* of the bone may occur either above, or below, the line of insertion of the deltoid muscle; in either case, there will be displacement of the portions of the bone, excepting in rare instances, when the fracture is strictly transverse, and has been caused by a force insufficient to throw the lower fragment from the axis of the upper; and even if the arm be not shortened, it will probably be somewhat curved by the action of the muscles, which operate from above the fracture upon the lower fragment.

When the fibres of the bone have been ruptured above the insertion of the deltoid, the upper segment will be drawn inwards towards the chest, by the action of the pectoralis major, chiefly, while the lower fragment will be drawn upwards and outwards by the combined action of the deltoid, and the triceps and biceps muscles.

If the fracture has occurred below the attachment of the deltoid, this muscle will raise the upper fragment outwards, while the lower portion will be drawn a little upwards, and inwards also with reference to the assumed position of the

upper fragment, by the contraction of the muscles which pass from the scapula to the lower part of the arm and the elbow.

Whether the shaft of the bone has been broken above, or below, the point under consideration, the indications of treatment will be the same, viz.: to restore the limb to its proper length and axis, if these have been altered, and to keep the parts at rest. This object will be best accomplished by the following plan, which is adapted to both of the supposed cases: — Envelope the arm, from the fingers to the axilla, by a roller applied so as to make uniform and moderate pressure upon the muscles; then, the arm being carefully supported by an assistant, take four splints made of thin wood, — (the sides of a cigar-box will answer perfectly well,)—and evenly padded with cotton, and apply them separately in front, and at the sides of, and behind the arm, and secure them in these situations by a roller. The splint for the anterior face of the arm should extend from the head of the bone to just above the bend of the elbow; the others from the same point to the extremity of the humerus, the projections of the condyles being carefully protected from too much pressure. After the splints have been bandaged to the arm, this should be brought a little forwards, so that the fore-arm resting in a sling, may be supported on the front of the chest, in the flexed position. In order to give greater security to the arm, a few circular turns of the roller should confine it to the chest.

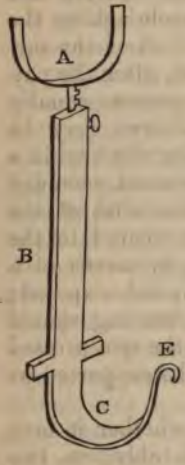
If, from any cause, it be desirable to dispense with the inner splint, the fracture may be treated equally well by securing a wedge-shaped pad in the axilla, the thick end downwards, so as to present a perpendicular surface from the glenoid cavity to the extremity of the humerus, upon which the latter may rest: then, having applied the roller, and the three other splints, as directed above, place the inner surface of the arm against the pad, and bandage it to the chest by circular sweeps of the roller: the fore-arm should be supported in a sling, as above directed.

Another modification of the same plan consists in substituting for the short splint, which is applied upon the inner aspect, or on the front of the arm, a rectangular splint, made to extend all along the inner or the anterior face of the limb,

from the head of the humerus to the ends of the fingers. Thus, all motion of the fore-arm will be prevented.

There is rarely much disposition to great shortening of the arm, in fracture of the shaft of the humerus; so that, in the vast majority of cases of this accident, the lateral pressure effected in the manner just described, is amply sufficient to retain the fragments in apposition. Mr. Lonsdale, however, has met with several cases in which he found it necessary to keep up permanent extension and counter-extension; and, to accomplish this object, he invented a splint which he thus describes:—"It consists of a thin bar of iron, about an inch and a half wide, and long enough to extend from the axilla to the elbow, — marked B in the wood-cut. (See fig. 48.) The lower end of the bar curves upwards underneath the elbow, so as to allow of this part of the limb fitting into it, at C. This curve terminates in a hook, E, for the attachment of a bandage; and on the splint opposite to this hook is a small bar, placed across the perpendicular, also for the attachment of a bandage. To the upper extremity of the splint a crutch is adapted, A, which fits underneath the axilla, and is movable up and down, being confined at pleasure by means of a small screw, placed at the side of the vertical bar." In applying it, the crutch-like extremity is secured in the axilla, the upper part of the arm fitting into it, and the elbow is confined in the inferior curve by means of a bandage passing around the limb at the elbow, and having attachments to the splint at the hook, and at the transverse bar, as already indicated. The whole arm should be enveloped by a roller, and one or two lath splints applied on the exterior, or anterior, surface of the limb; the fore-arm should be supported in a sling. (Lonsdale, op. cit., p. 173, &c.)

Fig. 48.



It is very conceivable that a splint of this kind would be of much use in cases of compound fracture of the humerus, where the limb cannot be wrapped in splints and bandages in the usual manner, and where some degree of compression

and support is required to keep the fragments, in any measure, in place. If employed in such cases, the straight splints and the enveloping of the limb should be omitted; but the arm should be lightly secured to the splint at the axilla, and also at the elbow, while another roller, or a bandage of Scultetus, shall at once serve to retain the fragments in tolerable apposition, to confine upon the seat of fracture any proper application, and to support the whole against the side of the splint. A little ingenuity on the part of the surgeon will enable him to form a splint of wood, after the pattern of Mr. Lonsdale, which will answer the purpose equally well. But compound fractures of the humerus may be treated very well, in most instances, by placing the arm in a curved splint made of sheet tin, or of pasteboard, moulded to an arm of somewhat larger diameter than that of the patient, and well padded; the limb should be secured to the splint, above and below the seat of fracture, by means of a roller carefully applied, and leaving the wound exposed; then, by a bandage of Scultetus, a suitable dressing should be retained upon the wound, and this part of the arm pressed gently against the splint: the fore-arm must be supported as usual.

After a certain time, when the fracture, whether it may have been simple or compound, has become tolerably firm, two curved splints, made of pasteboard, may be conveniently substituted for the ordinary lath splints; or the immovable apparatus may be used. The usual time required to insure the consolidation of this form of fracture is about six weeks.

2. Fractures of the upper extremity of the humerus.

The humerus may be broken either at its surgical neck, that portion of the bone, namely, which is included between the margin of the articular head and the point of the insertion of the pectoralis major muscle, or at its anatomical neck, a narrow rim of bone separating the curved head from the tubercles. Fracture at the surgical neck is much the most common.

When the bone is broken at the anatomical neck, there is often little or no displacement, the fractured surfaces being so broad at this point. But there is generally some derangement of the axis of the limb, the lower fragment being drawn

inwards by the pectoralis major, and upwards by the muscles which pass from the scapula to the lower part of the arm.

The displacement is greater when the fracture occurs at the surgical neck, for the upper fragment will be rotated outwards by the supra and infra-spinatus muscles, while the lower portion is acted upon as before mentioned.

In both cases the same indication is to be fulfilled, and it will be readily accomplished by confining a pad in the axilla, with the thick end downwards, so as to present a plane, perpendicular surface to the shaft of the limb; then apply a roller from the fingers up to the head of the arm, and having reduced the fragments to apposition, place a compress over the seat of fracture on the outer face of the arm, and upon this a curved pasteboard splint extending from the acromion process to the outer condyle; support the fore-arm in a sling, and confine the arm to the side of the chest by circular folds of a roller passing from the elbow to the shoulder. Or an angular splint may also be bandaged to the inner face of the arm and fore-arm, the hand being semi-pronated, — and the pad used as above.

The limb should be kept perfectly at rest for six or eight weeks, excepting that after the fracture has become sufficiently firm, passive motion should be gently made, every day or two, as the bandages are freshly applied.

3. Fractures of the condyloid extremity of the humerus.

Fig. 49.



The shaft of the bone may be broken just above the condyles, as is represented in the annexed drawing (fig. 49), taken from Sir A. Cooper's Treatise on Dislocations and

Fractures, p. 401, American edition; or the fracture may implicate the condyles themselves, "extending in three directions: First, the extremity only of either condyle may be broken off, as represented at A, in the wood-cut (see fig. 50). Secondly, the fracture may include a large portion of one condyle only, but extend directly into the joint, as at B.

Fig. 50.



Thirdly, both the condyles may be severed from each other, and from the shaft of the bone, as well as shown at C." (Lonsdale, p. 181.)

When the solution of continuity has involved the shaft of the bone, immediately above the condyles, the lower fragment will be drawn upwards and behind the humerus by the contraction of the triceps muscle, dragging with it, of course, the forearm, as represented in fig. 49,—or it may be drawn up on the front of the arm, depending, in a great measure, upon the direction of the force which caused the fracture. The same sort of displacement may ensue when the whole of the internal condyle is split off, as shown at B, fig. 50, since the ulna will be acted upon by the same muscles as in the other case; but there need not be this separation of the fragments, unless the violence has been sufficient to rupture the external lateral and the capsular ligaments. So also when the external condyle alone is severed from its bony connexions, the ligaments may still retain it in place, if they have escaped rupture; and displacement is still less necessary if the point merely of the internal condyle be broken off, as at A, fig. 50. But when, as at C, the condyles are not only separated from each other but from the shaft of the bone likewise, shortening of the arm is an almost certain result, from the operation of the same causes as when the shaft of the bone has been fractured above the epiphysis. The treatment in every case is pretty much the same, although the degree of success which attends it will vary

very much, agreeably to the extent to which the joint may have been implicated.

The method recommended by Sir Astley Cooper, when the shaft of the bone has been broken as above described,—and, with some modifications and additions, it is applicable to the other cases,—consists "in bending the arm, and drawing it forwards to effect replacement; then a roller should be applied while it is in the bent position. The best splint for it is one formed at right-angle, the upper portion of which should be placed behind the arm, and the lower portion under the fore-arm; a splint must also be placed upon the anterior face of the upper arm, and both should be confined by straps: evaporating lotions should be used, and the fore-arm be kept in the flexed position and supported by a sling. In a fortnight, if the patient be young, passive motion may be gently begun to prevent the occurrence of anchylosis; and in the adult, at the end of three weeks, a similar treatment should be pursued. But even after the most careful and judicious means which can be adopted, there is sometimes considerable loss of motion; and when the accident has not been understood, or has been carelessly treated, the deformity and loss of motion become very considerable." (See fig. 51, in which, however, the roller should have been represented as applied to the fore-arm and elbow.)

Fig. 51.



The mode of treatment generally adopted in this city consists in enveloping the limb, from the fingers to above the lin of fracture, in a roller, the fore-arm being flexed and the frag ments having been restored to apposition; then a flat, or slightly grooved, rectangular splint is applied upon the anterior face of the arm, fore-arm, and hand—or upon their inner aspect, the hand being semi-pronated,—and secured thus by means of a roller, a compress having been placed upon the

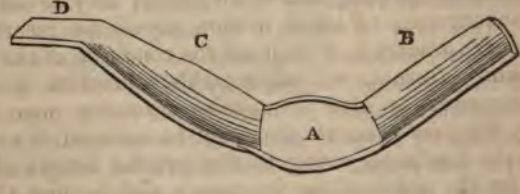
point of the internal condyle if this has been severed; the fore-arm should then be supported upon the chest by a sling. But if the fracture has involved the articular face of one or both condyles, it is advisable, in addition to the splint, to give increased support to the posterior face of the elbow. For this purpose a piece of pasteboard should be taken, sufficiently long to extend from three to four inches above the elbow, and for the same distance below it, and wide enough to envelope the joint laterally; this should be notched at different points, so that after it has been softened in hot water, it may be made to fit the elbow. Then, the arm having been bandaged, as before directed, and the anterior splint applied, this cap should be placed upon the posterior face of the elbow—care being taken to protect the bony projections from great pressure—and confined by the roller which secures the other splint. At the end of ten days or two weeks, or earlier if all pain has ceased and if the bone has become sufficiently firm, passive motion should be resorted to from day to day, the condyles being supported by the hand, and the angle of the anterior splint changed. After the lapse of eight or ten weeks, the confinement may be omitted. It should be borne in mind that daily motion of the joint is of the greatest importance in the treatment of fractures about the elbow, but it should be practised cautiously and with the limitations above mentioned.

When the fracture is compound, the same indications are still to be accomplished as when it is simple, and the same plan is to be pursued. The splints must be so contrived, however, as to allow of frequent inspection and dressing of the wound, without requiring the removal of the whole apparatus. This may be effected by using splints of binders' board previously softened and moulded to the shape of the part, and large enough to give easy support to the fractured limb; an aperture should be made in the splint opposite the wound, sufficiently large to permit of free examination of the injury to the soft parts. The limb should be softly cushioned in the splints, and secured to them above and below the wound, while the particular dressing required for the latter may be laid over the aperture corresponding with it in situation, and confined by the bandage of Scultetus. Or, when the wound is on the anterior face of the arm, the fore-

arm may be enveloped in a roller, as in the other cases, and a bandage of Scultetus be applied immediately to the upper-arm, over the wound, or upon the dressing which covers it, while a curved angular splint supports the posterior aspect of the whole limb. The fore-arm should be sustained by a sling in either case.

Mr. Mayo contrived a very simple splint for the treatment of a case of bad compound fracture of the condyles, by which the requisite support was given to the bones, and the wound still allowed to discharge freely, and sufficiently exposed to be dressed without much disturbance of the limb. As such instances sometimes occur, it is well to have an acquaintance with the mode employed to treat them, as adopted by so high an authority as Mr. Mayo. The apparatus "consists of two splints joined together by two small bars, so as to leave a space between them for the elbow to fit into. One of the splints, B, in the wood-cut, (see fig. 52,) is made for the back part of the arm to lie upon, while the other, C, is for the forearm; the second splint terminates in a horizontal portion, D, for the hand to rest upon; the intervening space, A, is formed by the two lateral bars, which are slightly curved outwards, to prevent pressure upon the joint." This splint should be padded, and the limb secured to it above and below the seat of injury, by an ordinary roller, while opposite the wound itself the bandage of Scultetus should be used for the same purpose, and also to retain suitable dressings upon the part. (Lonsdale, p. 189.)

Fig. 52.



With regard to the frequency with which the apparatus should be removed, and the fracture dressed, in cases of this injury generally, only conditional directions can be given. If, in a simple fracture, there be no unpleasant symptom or

appearance after the limb is first dressed, the bandage need not be removed for two or three days, and this quiescence of the limb is attended with many advantages, especially when the fracture has involved the joint directly or indirectly. But if the patient should complain of pain in the injured part, the envelopes should be removed at least once daily, and the injury examined; unless this attention is practised, sloughing of the soft parts, or troublesome excoriations, will often occur. The first application of the roller and splints should be made carefully, so as to exert only a moderate degree of pressure, and to allow of the swelling which follows upon almost every fracture; and the compression made around the lower part of the limb should be proportioned to that upon the upper, else the soft parts below will become swollen and painful, and finally gangrene may ensue.

In the wards of the Pennsylvania Hospital, in this city, it is rare that blood is taken from about the joint in case of fracture; but the fragments are placed in apposition as speedily as possible, and confined, as above advised, — perfect rest being considered a sufficiently powerful antiphlogistic remedy; frequently, indeed, this is aided by the influence of evaporating or sedative lotions, as diluted spirits, or lead-water.

In compound fractures, the best local application to the seat of injury, after the means hereinbefore advised for the promotion of direct closure of the wound have failed, is a poultice, or the water-dressing: if the former be used, it should be changed at least twice daily, and as much oftener as may be required by the amount or nature of the discharge: as the wound contracts, and the suppuration becomes very scanty, some stimulating lotion, or cerate, may be advantageously substituted. Passive motion should be resorted to, and diligently practised, as soon as the condition of the parts, internal and external, will allow; this injunction is of the utmost consequence after compound fractures near to, or involving, the joint, because it cannot be resorted to so early as in simple fractures, owing to the greater length of time requisite for the union of the fragments, and because also the joint has suffered more, in most cases, than in the other class of injury. In both, the rigidity of the parts may be lessened by frequently soaking the joint in warm water.

Comminuted fractures of the humerus require no different

treatment, as a general rule, from the simple, excepting rather nicer manipulation in reducing them, and in the application of compresses, and a somewhat longer confinement.

SECTION II.

FOR FRACTURES OF THE BONES OF THE FORE-ARM.

The complicated movements of the fore-arm, and the varied action of the numerous muscles necessary to effect them, occasion, when one or both bones are broken, many forms of displacement of the fragments. To remedy these, so as to preserve unimpaired the mobility of the limb, it becomes necessary for the surgeon to resort to a variety of expedients, which it is the object of this section to set forth.

In fractures of the fore-arm, whether of one or both bones, there is one common indication to be fulfilled, excepting when the fracture has occurred very near to the extremities of the bones;—this is to preserve the interosseous space, which is almost always encroached upon by the fragments.

1. For fractures of both bones.

The displacement in these cases may be in the diameter or in the length of the fore-arm, or in both directions. Generally, there is not much difficulty in retaining the fragments in proper apposition after reduction. The mode of accomplishing it, as it is commonly practised, consists in applying upon the anterior face of the fore-arm, a long compress which fits over the interosseous space, and then placing a straight, padded splint, sufficiently long to extend from the elbow to the ends of the fingers, upon the front, and another of the same length upon the back of the fore-arm, and securing them by circular and reverse turns of the roller. The width of the splints should be greater than that of the arm, so that the convolutions of the bandage shall not press the two bones towards each other.

Sometimes considerable difficulty is experienced in counteracting a lateral angular displacement: but generally this may be overcome by applying a compress of suitable thickness over the point of deformity, at the side of the fore-arm,

and by removing also, if necessary, the compression exercised upon the interosseous space at this point.

After the fore-arm is thus suitably dressed, it is placed in a position midway between pronation and supination, — the palm of the hand towards the chest, the thumb, which is left uncovered, presenting upwards,—and supported in a sling in the flexed position.

Both bones are not commonly broken at the same level but this circumstance does not alter the general mode of treatment.

Mr. Lonsdale objects to this mode of treatment, on the ground that the position in which the fore-arm is placed,— that of semi-pronation, — is not the one which is most calculated to insure perfection in the motions of the limb. The muscles which tend to throw the upper fragment of the radius in supination, are the supinator radii brevis and the biceps flexor cubiti, and, agreeably to Mr. Lonsdale's argument, these combined exert more power than the pronator muscle which operates upon this fragment,—the pronator radii teres; hence the upper portion of the radius is placed in a much more supine position than the lower, if the palm of the hand is turned towards the chest, with the thumb presenting directly upwards; and if union of the two fragments of the radius takes place in this faulty relative position, the extent to which pronation and supination can be effected will be impaired, as is not unfrequently noticed.

To obviate this difficulty, Mr. Lonsdale recommends that the hand be placed supine, and that two straight splints be bandaged to the fore-arm, precisely as in the ordinary plan of treatment; then the fore-arm should be supported in a sling, the elbow approximated to the chest, and the hand projecting before the body.

The splints should be retained for five or six weeks in fracture occurring to an adult, and for four or five weeks when a child is thus injured.

In compound fractures of the fore-arm, only one splint can be used, as a general rule, with advantage. Tolerably good apposition of the fragments can be effected with a single splint, by a judicious arrangement of compresses and a roller, or bandage of Scultetus; pressure upon the wound itself should be

avoided, but, on the contrary, every facility should be offered to the escape of the pus.

The "Ante-Brachial Hyponarthecia," of Sauter and Mayor is quite well adapted to the treatment of compound fractures of the fore-arm, of one or both bones. It is thus described by M. Cutler:

"Composition.—A board of convenient width, a little longer than the fore-arm and hand, a cushion, a cord for arc-loops, and three cravats.

"Application.—The fracture being reduced, the fore-arm is placed upon the cushioned board, *a*, *b* (fig. 53), which is immediately suspended from the patient's neck by means of the arc-loops, *e e*,—the ring *f*, and the cervical cravat, *g*. The second cravat, *c*, is now passed under the wrist, and crossed upon the back of the hand, the tails being then made to embrace the cushioned board, and knotted at its anterior border, as represented at *h*. The third cravat is made to pass around the apparatus at its upper part, so as to confine the corresponding portion of the fore-arm, and is then knotted as the other. If it be necessary to counteract any lateral displacement, a fourth cravat may be made use of, to serve as a 'traction ligature,' which will of course be knotted at the inner margin of the suspension-board." This apparatus leaves the fore-arm exposed to constant inspection, and suitable dressings can be applied to the wound without deranging the limb; if the discharge be very profuse, bran may be conveniently placed upon the board and around the arm to absorb the pus. When the patient lies down, the apparatus should be detached from the cervical cravat and placed upon a pillow, or suspended from the top of the bed, or from the ceiling. If it be deemed expedient, for greater security, to confine the whole limb, it can be very easily accomplished by selecting a longer board and cushion, extending from the axilla to the extremities of

Fig. 53.



the fingers, and employing a sufficient number of cravats arranged after the plan indicated.

2. For fractures of the radius.

This bone may be broken at its neck, at its carpal extremity, or at any intermediate point. The first and the last cases should be treated as if both bones of the fore-arm were broken; the hand may be placed in a state of semi-pronation, or in supination, as advised by Lonsdale.

It sometimes happens that the lower fragment of the radius, when the fracture is near the carpal extremity, is driven very forcibly towards the ulna, so as to require the operation of a force gradually exerted, and for a considerable time, to restore it to its natural line. For such cases Dupuytren recommended the following plan of treatment: "Take a bar of iron about an inch wide and of the length of the fore-arm, and which at its lower extremity, opposite the part corresponding with the wrist, curves downwards in a semicircle, to the concavity of which some buttons are placed at equal distances." Along the ulnar edge of the fore-arm, place a firm compress, extending from just above the extremity of the bone upwards, about an inch thick at the lower end, and gradually tapering: upon this compress apply the splint, its straight portion extending from the elbow to the termination of the compress, and secure it in this position by a roller which, on reaching the hand, causes the latter to approximate the curve of the bar, more or less, according to the amount of force required to rectify the displacement of the lower fragment of the radius, with which the hand is connected. (See fig. 54.)

Fig. 54.



The most common seat of fracture of the radius is at the lower or carpal extremity of the bone. Two varieties of this accident have been described: one by Dr. Colles, of Dublin, in the Edinburgh Medical and Surgical Journal, 1814, and the other by Dr. J. R. Barton, in the Philadelphia Medical Examiner, 1838.

Colles' fracture usually occurs from three-fourths to one

inch above the radio-carpal articulation, and is very much more commonly transverse than oblique. (R. W. Smith, Treatise on Fractures, &c., Dublin, 1847.) *Barton's* fracture, on the other hand, *extends obliquely into the wrist-joint;* and, perhaps in consequence of this implication of the joint directly, there is likely to be more inflammation of the articulation, and more permanent impairment of its motion than in case of Colles' fracture.

The resulting deformity is very much the same in both forms of the injury.

In this accident, the lower fragment of the radius, and with it the carpus, is drawn upwards upon the back of the fore-arm, as is represented in the annexed drawing (fig. 55.)

Fig. 55.



The treatment as advised by Dr. Barton, is very simple: place the fragments in apposition by drawing down the hand, the upper part of the fore-arm being fixed; then place a compress upon the posterior face of the lower fragment, and another on the anterior face of the upper, and apply padded splints along the anterior and posterior faces of the fore-arm, as directed for the other fractures; the splints should extend from the elbow to the ends of the fingers. After the lapse of a week or ten days, passive motion of the wrist and finger-joints should be commenced and repeated daily for five or six weeks, when the splints may be omitted. When the dressings are removed from time to time, the hand, and indeed the whole fore-arm also, should be bathed, otherwise the confinement will be attended with want of cleanliness of the part, and with a very unpleasant sour smell, disagreeable both to the patient and to the surgeon.

The line of fracture sometimes assumes the opposite direc-

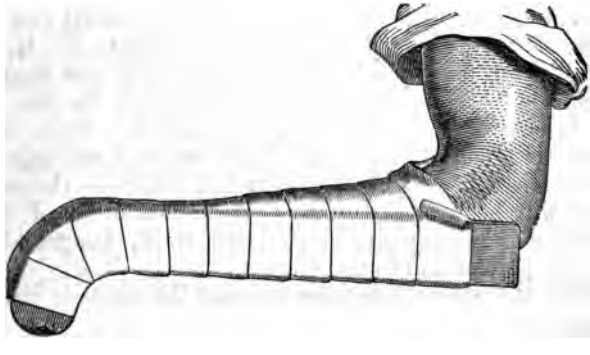
tion, extending from the dorsal face of the radius obliquely upwards to its palmar surface. The treatment is the same as in the first variety of the injury, a slight change being made in the disposition of the compresses to correspond with the different kind of deformity, as will at once suggest itself to the dresser.

During the continuance of the splints, and for some time later, the fore-arm should be supported in a sling.

The frequency with which these fractures of the radius occur, and the considerable impairment of the mobility of the wrist and the finger-joints which result from them, and which is sometimes permanent, especially in elderly persons, and in those who are subject to chronic rheumatism, have induced surgeons to devote a great degree of attention to their treatment. Consequently, the simple plan of treatment above described, has been variously modified.

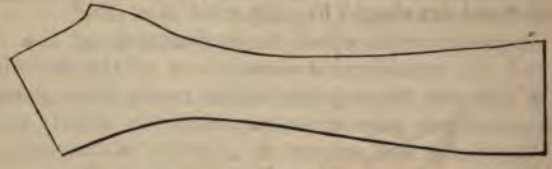
M. Nélaton recommends the following method: Bring the fragments into proper apposition by the necessary extension, counter-extension, and other manipulations; place the fore-arm in a position midway between pronation and supination, the hand being well brought down to its ulnar side; then apply a well padded pistol-shaped wooden splint, extending from the elbow to the extremity of the fingers, along the outer side of the fore-arm, with a compress opposite the lower fragment, and a straight splint along the inner face, reaching from the elbow to the wrist, well padded opposite the upper fragment, and along the radial border of the fore-arm, to counteract the tendency of this part of the bone to pronation. (See fig. 56.)

Fig. 56.



Dr. Bond, of this city, has contrived recently a splint, by the use of which the liability to stiffness of the joints is very much diminished. The splint is made of light wood, cut to the shape of the fore-arm, and extends from the elbow to the second joint of the fingers. (Fig. 57.) To its palmar ex-

Fig. 57.



tremity is to be firmly attached, by screws or nails, a carved and rounded block of wood of the size of the patient's hand, which the latter may grasp when the arm is extended upon the splint. The splint may or may not be, according to fancy or convenience, covered with binders' board, the edges of which shall project beyond the sides of the splint, and be turned up, so as to form a kind of box for the arm. (Fig. 58.)

Fig. 58.

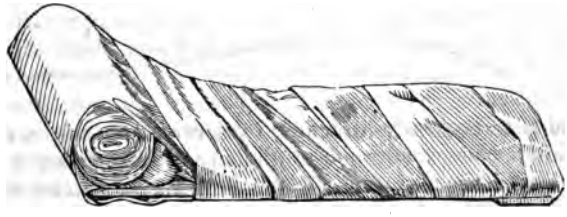


If the binders' board be not used, the splint is wrapped, as usual, in a roller or in muslin, the arm is placed upon it, the fingers are allowed to rest comfortably, or to be moved at pleasure, upon the carved block; a compress is to be placed under the arm at the point of fracture, just large enough to fill up any vacuity which the shape of the member may occasion after the fracture has been reduced. Another compress is to be laid upon the dorsal face of the limb, opposite the first, and the arm lightly secured to the splint by a roller. The patient is permitted to use as much motion of his fingers

and wrist as the apparatus will allow. (See Dr. Bond's paper in the American Journal of Medical Sciences, April, 1852.)

If Dr. Bond's splint be not at hand, (any surgeon, however, can make one in a few minutes, of a shingle and a block of pine wood), a common splint of the proper length can be prepared in imitation of Dr. Bond's, by wrapping a roller about it, as recommended by Dr. Hays, and as illustrated in the annexed drawing. (Fig. 59.)

Fig. 59.



Frequently, patients become wearied of any splint, after a certain time, the confinement of the arm in a particular position being irksome to them. If this be the case in the treatment of these fractures by Bond's, Hays', Nélaton's or Barton's plan, the splint suggested by Good, which is applied to the back of the fore-arm, may be employed.

Latterly, it has been proposed by Professor Fauger, of Copenhagen, to treat these fractures without splints. "The hand having been brought into a position of strong flexion, the fore-arm is placed, pronated, on an oblique plane, with the carpus highest, the hand being permitted to hang freely down the perpendicular end of the plane." (London Lancet, May 8, 1847.)

3. For fractures of the ulna.

The ulna may be broken in its shaft, or at the coronoid or olecranon processes. The first-named variety is treated after the same method as when both bones are involved; fractures of the processes require a different plan.

When the coronoid process is broken off from its bony and ligamentous connexions, the brachialis anticus muscle, which is inserted upon it, draws it up on the lower portion of the humerus; and the chief difficulty in treating this accident

successfully consists in counteracting entirely the force of this muscle, so as to maintain the fragments in perfect apposition. There is also another cause of failure, since when this process is detached, "like the head of the thigh-bone, it loses its ossific nourishment, and has no other than a ligamentous support. Its life is preserved by the vessels of the reflected portion of the capsular ligament upon the end of the bone, which do not appear capable of supporting the least attempt at ossific union." (Sir A. Cooper, op. cit., p. 406.)

For the treatment of this injury, apply a roller from the ends of the fingers, around the fore-arm and about the elbow, making firm pressure upon the restored process, through the intervention of a compress, and then continue the roller around the arm, so as to confine the brachialis anticus: over the roller place an angular splint, extending from near the the head of the humerus to the fingers, along the anterior surface of the limb, and retain it thus by a roller. The fore-arm should be supported in a sling, and the apparatus should be worn for six or eight weeks, passive motion being resorted to very cautiously. The splint which is employed should be flexed at rather less than a right angle, in order that the brachialis anticus may be relaxed as much as possible, and every facility be afforded for a bony union of the fragments.

The angular splints for the upper extremity may be made with the angle fixed, or this may be movable and changeable at pleasure, the two segments of the splint being fastened at the desired angle, by a pin traversing both portions: if the former arrangement be adopted, it will be necessary to have a multiplicity of splints made at different angles; by the latter, the same splint will answer the purposes of all the others.

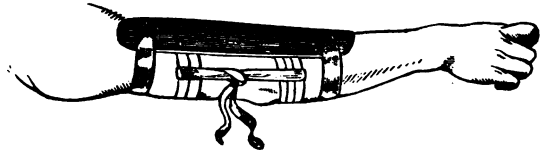
The olecranon process is more frequently broken than the coronoid, and the reparation of the injury is equally, if not more, difficult. The triceps muscle acts upon the fragment of bone to great advantage, so that when the ligamentous fibres are severed, which connect it with surrounding points, the retraction is sometimes very great.

The indication is, of course, to relax the muscle, so that the fragments may be kept in apposition; the fore-arm should

be extended upon the arm, and some means should be resorted to for securing the broken surfaces together.

Sir Astley Cooper advises the following plan of treatment: —"If there be much swelling and contusion, it is right to apply evaporating lotions and leeches for two or three days; and after the inflammation is reduced, a bandage should be applied."—"If the swelling and inflammation do not prevent it, the surgeon is, at once, to place the arm in a straight position, and to press down the upper portion of the fractured olecranon, until he brings it in contact with the ulna; a piece of linen is then laid longitudinally on each side of the joint; a wetted roller is applied above the elbow, and another below it; the extremities of the linen are then to be doubled down over the rollers and tightly tied, so as to cause an approximation; thus the portions of bone are brought and held together; a splint well padded is to be applied upon the fore part of the arm, to preserve it in a straight position, and confined to it by a circular bandage; the whole finally, is to be frequently wetted with spirits of wine and water." (See fig. 60.)

Fig. 60.



"In a month the splint is to be removed, and passive motion is to be begun; but, if it be attempted earlier, the olecranon will be separated from the shaft of the bone, and the ligament will become lengthened and weakened; all attempts at motion must, therefore, be made with the greatest gentleness." (Sir A. Cooper, op. cit., p. 410.)

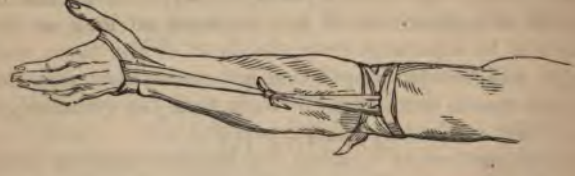
Another method of treating this fracture consists in applying a roller from the fingers to the elbow, then drawing down the fragment of the olecranon to its natural situation; and while an assistant holds it thus, by means of a compress placed just above it, the surgeon makes a few figure-8 turns around the elbow, permanently confining the compress and

the process of bone, and exhausts the roller upon the upper arm. A straight splint is now taken and laid upon the front of the limb, extending from near the head of the humerus to the wrist; some cotton should be interposed between the splint and the bandage at the bend of the elbow, in order to fill up the vacuity at this point,—the fore-arm not being extended quite to the utmost,—and the whole secured by another roller.

The same precautions, with regard to the institution of passive motion, are to be attended to, as in the other method.

The extension of the fore-arm, and the confinement of the fragment of the olecranon, may be effected also by the "olecrano-metacarpal cravat" of Mayor, as follows:—Extend the fore-arm, and place upon its anterior face a pasteboard splint moulded to its form, and reaching from the lower third of the upper arm to the fingers; draw down the fractured process to the corresponding surface of the ulna, and upon it lay a compress, which should be held by an assistant; then pass a cravat around the lower extremity of the humerus, so as to retain in place the splint and the compress, and knot it behind, leaving the tails hanging about half way down the back of the fore-arm; to the palm of the hand, below the ball of the thumb, apply the centre of another cravat, and tie it upon the back of the wrist, thus securing the lower extremity of the splint, the tails of the cravat being free; now tie the ends of the two cravats together. (See fig. 61.)

Fig. 61.



This method can scarcely be relied upon for the permanent treatment of this form of fracture, when the other methods can be employed.

Desault advises that the fore-arm should be maintained in a

state between semi-flexion and extension, in case of fracture of the olecranon process, and that a splint slightly curved be applied on the anterior face of the limb, as in the plans already mentioned.

In compound fracture of this portion of the bone, the limb should be extended by means of a splint laid upon its anterior face, and confined thus by a roller, which, however, should not cover the wound; the edges of the latter should be retained in apposition by strips of adhesive plaster, and over it a piece of lint saturated with blood or solution of starch should be applied, the whole being enveloped, and the elbow tightly confined to the splint, by a bandage of Scultetus. The patient should be kept in bed with the arm extended on pillows, the hand elevated rather higher than the shoulder. If no unpleasant symptom occur, the dressing should be undisturbed for a week or ten days. Treated in this way, these injuries are sometimes very well recovered from. But if inflammation and suppuration come on, the accident must be treated as ordinary compound fractures presenting the same symptoms; here again, adhesive strips properly applied, so as to maintain the necessary degree of extension and counter-extension, will be found of great service in the treatment.

Partial fractures of the bones of the fore-arm, those namely in which some of the fibres only of the bone are ruptured, the others being bent, require the same treatment, in general terms, as the complete fractures. After the line of the bone has been restored, however, by suitable manipulations, there is usually less disposition to a reproduction of the deformity, and hence less compressing force is required to counteract it; generally, too, union takes place sooner than in the other cases, and the splints need not be worn so long as in the latter.

SECTION III.

FOR FRACTURES OF THE BONES OF THE WRIST AND HAND.

1. Fractures of the carpal bones are almost necessarily compound and attended with much injury to the soft parts; they

require no especial apparatus to keep them in place. The best plan of treatment in such cases is, to adapt a splint to the lower part of the fore-arm and hand, increasing in width at the wrist, being retained lightly in this situation by a roller, or bandage of Scultetus; if the wound is on the palmar surface of the wrist, the splint should be applied to the back of the fore-arm and hand, and vice versâ. If, as is generally the case, there is no probability of securing direct closure of the wound, poultices, or water-dressings, should be laid upon it, at first, or the treatment by irrigation should be adopted, and other applications used as required: the fore-arm and hand should be supported in a sling, or should repose upon a pillow, as most expedient.

2. Simple fractures of the metacarpal bones are, in general, attended with but little displacement; after the fragments have been restored to apposition, they are easily retained in situ by merely laying a compress upon the bone, and confining it thus, with the hand and fore-arm upon a broad splint as above.

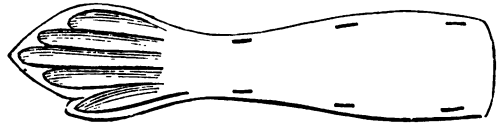
3. Simple fractures of the bones of the fingers require for their treatment merely that the fingers shall be supported by a thin strip of pasteboard placed on each side of them, and confined by a piece of tape applied in circular turns. For greater security and to insure perfect repose to the injured finger, the hand and fore-arm should be bound to a splint, as in the cases just considered, and supported in a sling.

4. Compound fractures of the metacarpal and phalangeal bones are often met with, as occasioned by the bursting of firearms, the explosion of rocks, and by the hand becoming entangled in machinery. Such injuries appear very formidable at first, and as if beyond reparation; but the hand is of such vast importance to the patient,—and the accident generally happens to those who earn their subsistence by their daily labour,—that an attempt at saving it should be made, and the most unpromising cases do very often recover with very useful hands.

A splint long enough to extend from the elbow to the ends of the fingers, or a little beyond them, and grooved on its palmar portion to receive the fingers (see fig. 62), should be padded with cotton, or covered with a poultice or other suitable dressing, and placed underneath the limb: a roller

should be passed around the fore-arm and splint, to retain the latter in place, and this, with the weight of the dressings that are laid upon the hand, will be found in most cases to be suf-

Fig. 62.



ficiently retentive for the latter. Generally, the continued application of cold water upon the lacerated parts, will prove the best and the most agreeable dressing that can be employed; it should be used as advised under the head of irrigation, in the first part of this volume. The feelings of the patient form the best guide as to the length of time during which this application should be retained; so long as he finds it comfortable, it may be continued; so soon as he complains of increasing pain in the injured part, or if he becomes chilly under its use, it will be best to substitute for it a warm poultice, or folds of soft lint saturated with warm water; and the dressings should be varied to suit the particular conditions of the wound. When there is free suppuration, particularly in warm weather, the bran dressing will be found very serviceable, as it not only absorbs the discharges, but covers the injured parts and renders it less likely to be infested with vermin, — a source of much trouble and annoyance both to the surgeon and the patient. (Some of the strong aromatic oils are of service in destroying these nuisances; but it is generally necessary to dislodge them from their burrowing-places by means of the dissecting forceps, and by injecting a stream of water upon them from a small syringe.)

After the suppuration has in a measure ceased, and the wounds have assumed the appearance of healthy ulcers, the hand may be placed upon a flat splint, of the same shape as the other, and the bones pressed into proper line, by inserting pledgets of lint between the fingers and using gentle compression upon the whole hand by the folds of a bandage of Scultetus, enveloping both the hand and the splint; the tendency to recurring displacement of the fragments of bone is

so slight in these cases, that very little force is requisite to keep them in tolerable apposition.

During the early part of the treatment, the patient should be kept in bed, with the arm reposing upon pillows, the hand somewhat elevated; in the latter stages, he may be allowed to leave the bed, with the arm supported in a sling.

The disposition of the pus to run underneath the soft parts, forming collections at points remote from the wound, should be counteracted by position, by compression, and finally, if it can be prevented in no other way, by incisions practised wherever a deposit is formed.

CHAPTER V.

ON THE APPARATUS AND DRESSINGS FOR FRACTURES OF THE BONES OF THE LOWER EXTREMITY.

SECTION I.

FOR FRACTURES OF THE OS FEMORIS.

GREATER difficulty is experienced in the treatment of fractures of the femur, than in those of any other bone. The constant action of powerful muscles; the injurious effects of pressure upon the soft parts, from long-continued position, and from the compression of bandages; the hurtful influence upon the general health of protracted confinement, and the direct impression upon the system resulting from the injury itself, are all to be combated in the same case. The attention which has been devoted to the consideration of this subject, has been proportioned to its importance.

The proper position in which the thigh shall be maintained during the treatment, is the main point of discussion among surgeons — some preferring the flexed, others the extended position of the limb. A variety of apparatus, more or less complicated in structure and arrangement, has been contrived with reference to each plan of treatment.

1. Modes of treatment, the thigh being in the *flexed position*.—This position is most in vogue in Great Britain; it was first particularly recommended by Mr. Pott, who founded it upon the idea that it is possible "to put the limb into such a position as shall relax the whole set of muscles belonging to, or in connexion with, the broken bone." This idea is manifestly incorrect, since the position which relaxes the flexor muscles renders the extensors more tense; that which approximates the extremities of the adductors has the reverse effect upon the abductors.

The following is the plan of treatment adopted by Mr.

Pott: — "The position of the fractured os femoris should be on its outside, resting on the great trochanter; the patient's whole body should be inclined to the same side; the knee should be in a middle state between perfect flexion and extension, or half-bent; the leg and foot, lying on their outside also, should be well supported by smooth pillows, and should be rather higher in their level than the thigh; one very broad splint of deal, hollowed out and well covered with wool, rag, or tow, should be placed under the thigh, from above the trochanter quite below the knee; and another, somewhat shorter, should extend from the groin to below the knee on the inside, or rather, in this posture, on the upper side. The bandage should be of the eighteen-tail kind, and when the bone has been well set, and the thigh well placed upon the pillow, it should not, without necessity, (which necessity will, in this method, seldom occur,) be moved from it again until the fracture is united; and this union will always be accomplished in more or less time, in proportion as the limb shall have been more or less disturbed." (Cooper's Surg. Dict.) The chief and sufficient objections to this plan of treatment are, that the means employed are insufficient to keep the ends of the fragments in apposition, and too insecure against sudden and accidental movements of the limb, or of the whole body; and that the pressure exerted upon the trochanter for the space of many weeks is too great to be safely borne.

There are some cases, however, in which this position may be adopted as a temporary one; these will be mentioned hereafter.

Sir C. Bell recommended another method of treating this class of injuries in the flexed position of the thigh:—The patient lies upon his back, while the limb is supported upon a double inclined plane, one portion of which extends from the tuberosity of the ischium to the ham, and the other from the ham to the heel; straight splints are confined to the outer and inner sides of the thigh. Numerous apparatus have been contrived, in modification of the original suggestion of Bell, some of which are much used in England.

2. The plan of treatment by the *straight position* of the limb was first employed by Desault. In this method, a constant extending and counter-extending force is maintained

upon the fragments, while lateral pressure is exerted upon the limb by means of splints and bandages. The original apparatus of Desault has been modified and improved upon, in various ways, by European and American surgeons, so that fractures of the thigh may be more successfully treated in the straight position, than in any other.

The os femoris may be broken at its condyloid, or trochanteric extremity, or at any point in its shaft; and although the general plan of treating the injury, at whatever part the fracture may have occurred, is the same, yet there are some minor points of difference, which are nevertheless of importance in practice.

1. For fractures occurring in the shaft of the bone.

The injury may be simple or compound, and the line of fracture transverse or oblique. Displacement of the fragments almost invariably occurs, even when the bone is transversely broken, for the force which caused the fracture nearly always deranges the axis of the bone, pushing the two portions from contact with each other, and then the muscles have uncontrolled action, and draw the lower fragment upwards, above, or underneath, the superior. Even if the contact of the extremities of the two portions, at the point of fracture, be not completely sundered by the original violence, the muscles which pass from the pelvis to the lower extremity of the femur will act upon the latter, and thus derange the natural line of the bone. But when the fracture is oblique, shortening of the limb is a necessary consequence, and its degree will depend very much upon the muscular development of the patient.

The solution of continuity may occur at any point between the smaller trochanter and the condyles, but its most frequent seat is within the lower two-thirds of the bone. The inferior fragment is drawn upwards and, generally, inwards by the extensor and adductor muscles, while the superior is elevated at its lower extremity by the action of the iliacus internus and psoas magnus, and this tilting-up of the fragment will be greater or less, as the fracture is near to, or remote from, the insertion of these muscles. The direction which the upper portion of the bone will assume will be modified also by the operation upon it of the glutæus maximus, if the fracture be above the middle of the shaft,—it will be thrown outwards.

And farther there is almost invariably a considerable degree of eversion of the foot as well as of the lower end of the upper fragment, in consequence of the weight of the limb, or the contraction of the external rotator muscles of the thigh. The choice and management of the apparatus employed to treat a case of fracture of the shaft of the femur must, of course, be based upon its adaptation to the counteraction of these causes of deformity. It will be most convenient, with reference to this point, to consider, first, the different kinds of apparatus used in the treatment of these injuries, in the flexed position of the limb; and, secondly, those adapted to the extended position.

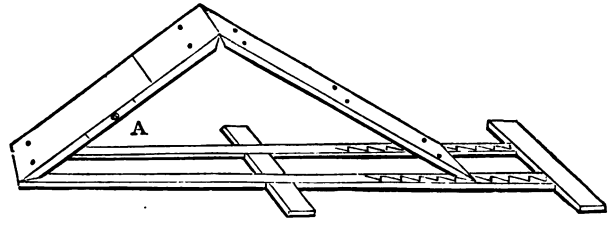
The plan proposed by Pott has been already described, and the objections to it have been stated: it should not be adopted in ordinary cases as a permanent method of treatment, but in some instances it may be used with advantage. Thus, when there is much contusion of the soft parts, or in cases of compound fracture with the wound on the under surface of the thigh, as may perhaps happen occasionally, it is the only plan which can be resorted to, — temporarily in the first class of cases, and as a permanent mode in the latter.

The apparatus contrived by Sir Charles Bell consisted of two boards, ten or eleven inches wide, one of which was made to extend from the tuberosity of the ischium to the popliteal flexure, and the other from the latter point to the heel: these two portions of the apparatus were united at an angle under the knee-joint, while their other extremities were connected by a horizontal piece, which served also to support the double inclined plane upon the bed. Holes were pierced along the margin of the inclined planes, in which pegs were inserted to steady the limb. When about to be used, the apparatus was placed upon a mattrass, the inclined surfaces covered with a cushion, and the limb laid upon it, so that the under surface of the knee should correspond with the angle of the plane, and the tuberosity of the ischium should check against the upper extremity of the horizontal board. A lath splint was bound to the upper surface of the thigh, and another along the inner face of the same.

Many modifications of this simple apparatus have been contrived since the original was proposed. Mr. Lonsdale's book contains a description of the one which was — at the

time he wrote, 1838, — in ordinary use at the Middlesex Hospital, London, and which, he thinks, "possesses all the advantages that the more complicated ones are said to have." It differs from the one just described in having the planes joined by means of a hinge at the point corresponding with the knee; and the same sort of union exists between the thigh-piece and the horizontal frame, while the portion on which the leg reposes may be fixed at any angle upon the latter, by means of a serrated edge. "The letter A marks the screw that secures a slide in the thigh-portion of the plane, to allow of the latter being adapted to limbs of different lengths." (See fig. 63.) A slide, having a foot-board

Fig. 63.

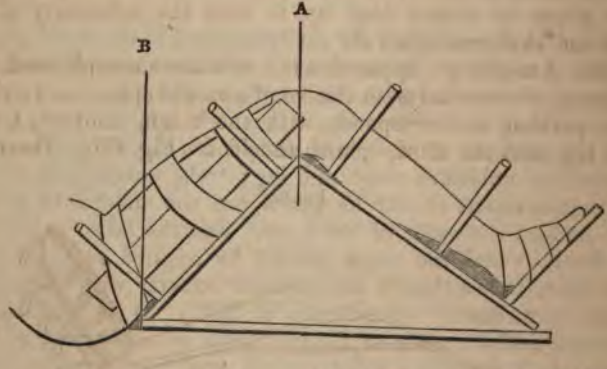


attached to it, could be very easily adapted to the lower plane, so that it might be fastened at a suitable distance from the angle, to correspond with the length of the leg.

In making use of this apparatus, the length of the thigh and leg portions of the plane should be made to agree with that of the unbroken thigh and leg; "the points from which the measurement should be taken are the tuberosity of the ischium and the angle of the knee," and the latter point and the heel; "and the plane should be applied to the sound limb first, to see that it corresponds exactly with the points above mentioned." (Lonsdale, p. 298.) It is advised to have the cushion made of flannel folded several times, as this is supposed to offer a more smooth and level surface, upon which the limb shall rest, than if pillows are employed. The whole limb is then gently raised, the thigh and leg being flexed, and the seat of fracture carefully supported, the plane, having a bandage of Scultetus arranged upon the thigh-portion of it, slid underneath, and the limb now lowered

gradually down upon it. Care should be taken that the angle of the knee corresponds exactly with that of the plane, and that the tuberosity of the ischium presses well against the upper extremity of the apparatus. The hand should be passed gently underneath the limb, and the cushion smoothed. The proper angle of the plane must be determined by the degree of elevation which may be required to make the line of the lower fragment level with that of the upper, — the latter, as has been already pointed out, being tilted more or less upwards by the action of the psoas magnus and iliacus internus muscles. An assistant should support the limb while the surgeon confines upon the outer, upper, and inner aspects of the thigh three splints of the length of the bone, by means of the bandage of Scultetus. The limb is secured to the plane by a roller, the foot is attached to the foot-board by the same means, and the legs are inserted into the holes made for them. The annexed drawing, taken from Mr. Lonsdale's book, p. 302, "represents the apparatus when properly applied. The lines A, B, show the two important points that are to be attended to;—A, that the angle of the

Fig. 64.



knee corresponds with the angle of the plane — B, that the tuberosity of the ischium presses well against the upper end." (See fig. 64.)

Any disposition to the lateral angular deformity, in consequence of the glutæus maximus muscle acting upon the upper

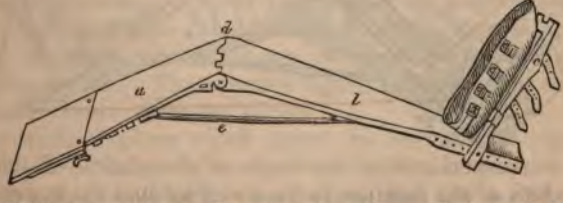
fragment, may be easily counteracted, by directing the apparatus outwardly from the middle line of the body, thus giving the lower fragment a direction parallel and continuous with that of the upper.

The chief modification of this simple apparatus is that of Mr. Amesbury, who contrived it to remedy the objections which appeared to him to be well-founded against the other: these objections were, that it allowed of motion of the pelvis, and consequently of the upper fragment, thereby disturbing the apposition of the broken extremities of the bone, and that it did not allow of sufficient extension being made. It will be seen, by examining the double inclined plane above described, that the pelvis is not well confined, and that the counter-extension is effected chiefly by the weight of the body, aided by the pressure of the apparatus against the tuberosity of the ischium, and by the attachment of the upper fragment to the thigh-portion of the plane, — while the extension is made by the weight of the leg and its confinement, together with that of the foot, to the lower plane and foot-board.

Dr. Spaulding, of Buffalo, has been very successful in treating these injuries by the inclined plane. He fixes the pelvis more securely, by allowing the horizontal portion of the plane to extend high up, so that the tuberosity of the ischium shall rest *upon it*.

Mr. Amesbury's apparatus is much more complicated. It consists of three parts, exclusive of straight splints and straps: one portion, *a*, corresponds with the thigh, another, *l*, with the leg, and the third, *c*, with the foot. (Fig. 65.) There are

Fig. 65.



two thigh-pieces to each apparatus, "one is bevelled off at the lower end to the right; and the other to the left," to render the shape of the upper part of the plane conformable

to that of the thigh, — a perfectly-formed thigh being not straight, but curving a little inwards towards the knee. The thigh and leg-pieces are connected together by a hinge-joint, fastened by a pin, *d*. The foot-board is fitted upon the lower plane at a right angle, and may be fixed at a greater or less distance from the angle of the two planes, by means of a pin or a screw. The length of the thigh-piece may be adapted to any limb, by means of a sliding plate which is arranged at its upper part, and which may be fixed as required by a screw. The two portions of the plane are connected underneath by a steel rod, *e*, and the angle of the plane may be altered at pleasure, by varying the point of fixation of this rod to the under surface of the thigh-piece, a rack being there placed with several projections, each of which has a hole bored through the middle, for the purpose of receiving a bolt, which also perforates the extremity of the rod. At the back of the sliding plate, a couple of bars are placed, which serve to render the plate more secure, and also to confine the pelvis-strap which retains the apparatus in apposition with the ischium.

In applying this apparatus, it should first be adapted to the sound limb, in order that the proper length may be ascertained. Then, the requisite angle having been given to the planes, and their surfaces smoothly and evenly cushioned by means of flannel, the broken limb should be carefully deposited upon the apparatus, a roller having been previously

Fig. 66.



applied from the foot to the knee. The shoe, *a* (see fig. 66), should now be buckled over the foot securely, and the pelvis-strap passed between the bars and the plate of the sliding portion of the thigh-piece. The leg should be confined to the

lower plane, by a roller, *d*, and the fragments of the femur properly adjusted, by extension and counter-extension, and retained in position by three straight splints, one on the outer, *e*, another on the upper, *f*, and the third on the inner face of the thigh, in which situations they are secured by the straps, *g*, *g*, *g*, fixed to the back of the apparatus. "The pelvis-strap, *h*, should now be carried round the limb under the strips of leather, on the back of the short splints, and made to cross on the outer side, and then the buckle-end with the sliding-pad should be conducted round the pelvis, and made to meet the other end in front, where it should be buckled."

When there is much inflammation, Mr. Amesbury omits the front splint, and applies evaporating lotions, &c., &c.

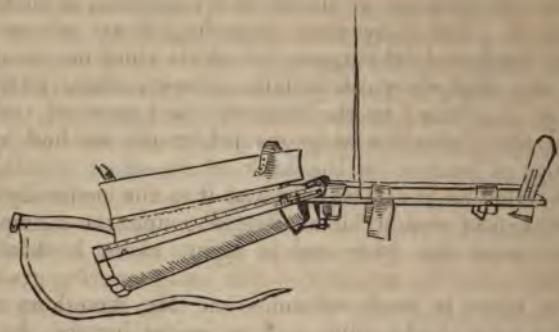
When the apparatus is thus securely arranged, it may be placed on its side, or rest upright. Mr. A., thinks that "half way between the side and the heel is a better position for a continuance. I generally," he continues, "place the apparatus upright, or a very little rolled outwards. It is maintained in either of these positions by pillows, assisted by a couple of tapes, *i*, *i*, carried from the lower end of the apparatus to the foot of the bed."

This apparatus certainly seems to offer much more security than the more simple one before described, and by it, according to the testimony of its author and many others, cures are effected of fractures of the thigh, without apparent shortening of the limb.

Professor Nathan R. Smith, of Baltimore, has constructed a very light and portable double inclined plane, for the treatment of these injuries, which is believed to be equally valuable and efficacious. A full account of it may be seen in "Gedding's Baltimore Medical and Surgical Journal," vol. i. 1833. It allows of suspension of the limb, and a gentle swinging motion. The annexed figure will convey an idea of its construction. (See fig. 67.)

The inclined plane which seems to be most in vogue in England, is M'Intyre's, as modified by Mr. Liston. It consists of a thigh and leg piece of sheet iron, and a foot-board of wood; the former are connected together by a couple of hooks and a screw, which is so placed that the two plates can be set to any angle at which it may be desirable to bend the

Fig. 67.



knee; and the foot-board is affixed in such a manner, that it may be slid upwards or downwards to suit the length of the leg, and fastened by a side-screw in any position that may be wished. At the lower end of the apparatus there is a cross plate of iron, which is so attached, that if the foot be raised or depressed, the plate will always rest flatwise on the mattrass, or a board placed at the foot of the bed for the purpose of supporting it. (Fig. 68, taken from Fergusson's book.)

Fig. 68.



The hyponarthecia of Mayor and Sauter, is a modification of the same principle, — a double inclined plane, upon which the thigh and leg are confined, in the same manner as is the arm in the hyponarthecia for the upper extremity; as in the latter case, the apparatus is suspended from the bed or ceiling. Those who would see a drawing of this apparatus, are referred to the book of Mayor, to that of Cutler, or to that of Dr. H. H. Smith.

The only way in which any individual can form a satis-

factory opinion, as to the real comparative efficacy of the treatment of fractures of the thigh by position, is to test it for himself. The statements respecting it are of the most opposite kind, and by surgeons of equal eminence,—among whom are Amesbury, Lonsdale, Cooper, Bell, Earle, in favour of it, while Liston, Fergusson, and most of the continental and American surgeons prefer the method by extension.

This latter mode of treatment, as it is now generally practised, was proposed by Desault. The apparatus employed by him consisted of two straight splints rather broader than the antero-posterior diameter of the limb, tapering gradually from the upper to the lower end,—one long enough to extend from the crest of the ilium to four inches beyond the foot, and the other from the perineum to the sole of the foot along the inner side of the limb; near the upper end of the long splint a hole was perforated for the attachment of the counter-extending band, and a notch was cut at the lower extremity, with a perforation just above it, for the securing of the extending strap. The rest of the apparatus consisted of a splint-cloth; long pads filled with chaff, to equalize the pressure of the splints along the outer and inner faces of the limb; a counter-extending band, to pass between the pubis and the upper part of the thigh, and to be attached to the upper extremity of the long splint, and an extending band, for the purpose of firmly connecting the foot with the lower end of the same splint; lateral pressure was made by means of several strips of muslin, which drew the splints and the pads firmly against the limb on each side, while the thigh was enveloped in a bandage of Scultetus.

The objection to this particular apparatus is, that the extending and counter-extending forces do not act sufficiently parallel with the axis of the limb. This difficulty is obviated by the very simple modification which Dr. Physick made of the apparatus of Desault. This consisted in making the outer splint long enough to extend from the axilla to about four inches beyond the sole of the foot, and in attaching to its inner side, at about two inches above its lower end, a block, grooved on its inner margin, and broad enough to reach the line of the middle of the foot (fig. 69); the other component parts of the apparatus are the same as are used

in Desault's. The counter-extending band is best made by filling a narrow bag of muslin, about three-fourths of a yard long, firmly with bran, or oat-chaff, so as to form a cylinder of an inch in diameter; to each extremity a piece of strong tape should be securely sewed, for the purpose of attaching the band to the upper extremity of the splint; when this is applied, a piece of soft buckskin should be interposed between it and the skin, as a preventive of excoriation and chafing. Extension is best effected by means of a gaiter, similar in shape to that represented in the annexed wood-cut (see fig. 70); it should be made of strong muslin lined with soft buckskin, both to be cut "*bias*," so that the gaiter will set smoothly to the ankle; stout tapes should be attached to its lower edge, one on each side, to make traction upon it and to secure it to the splint, and three or four shorter tapes should be sewed to each free margin, to tie the gaiter upon the anterior part of the foot. Previous to its application, the ankle should be bathed with whiskey, or soap-liniment, or spirits of camphor, and enveloped smoothly in a pad of soft carded cotton; then the gaiter should be fitted nicely to the part, and tied. The following plan may be pursued in arranging and applying this apparatus, or that of Desault: Place upon the mattrass, and in a position to correspond with the fractured limb, the splint-cloth — a piece of muslin about two yards long, and as wide as the length of the inner splint, — and upon this arrange the strips of a bandage of Scultetus; then lay the patient carefully upon the mattrass, so that the broken thigh, previously divested of clothing, shall repose upon the strips and the splint-cloth; next pass the perineal band under the buttock, and tie the gaiter around the ankle, as before directed; the limb being carefully steadied by an assistant, roll the splints in the cloth, commencing at the margins, leaving only space enough between each side of the limb and the corresponding splint, thus enveloped, to admit of the presence of the junk-bag, — the long pad before spoken of. (The proper rolling up of the splints requires some time and

Fig. 69.



trouble — they should be tightly wrapped, so that when pressure is used laterally upon the limb, they may not slip, and thus leave a larger space between them and the leg than is compatible with the accomplishment of one of the objects for which they are employed, viz., the exercise of an equable and firm compression upon the limb, by the aid of the junk-bags.)

Fig. 70.



The splints being thus prepared for use, extension and counter-extension should be made by assistants, the one grasping the foot and ankle, and the other fixing the pelvis — by one hand passed between the thigh and the pubis and ischium, and the other on the outside of the hip — while the surgeon coaptates the fragments, and adjusts the shape of the thigh; he then arranges the bandage of Scultetus, and afterwards presses the junk-bags and the splints firmly against the sides of the limb; the counter-extending and extending bands should now be tightly secured to their corresponding extremities of the long splint,—the tapes attached to the gaiter passing over the grooved margin of the block, before described. To secure the limb in this adjustment, three or four strips of muslin should be passed underneath the apparatus, at intervals along the limb, and tied across, the knot being made upon the edge of one of the splints, to prevent it slipping; and a broad band should likewise confine the upper part of the long splint to the side. It is sometimes advisable to give additional support to the foot, by tying a strip of muslin around it, and then pinning the ends to the splint-cloth. An arched frame of wire, or of hoop, should be placed over the foot, to protect it from the pressure of the bed-clothes.

The limb should be placed out from the axis of the body, particularly in those cases where the fracture is at such a point as that the glutæus maximus muscle will draw the upper fragment of bone outwards.

It is well to use the bandage of Scultetus during the first few days after the injury, since it makes gentle and equable pressure upon the muscles of the thigh, and assists somewhat to keep the fragments of the bone in apposition; after

the first week or ten days, however, it is probably as well, or better, to remove it, leaving the thigh exposed to the eye of the surgeon.

Cold lotions should be applied at any time, as they may be called for by the condition of the soft parts; anodyne liniments are sometimes of service in allaying muscular irritability, and in alleviating pain in the limb.

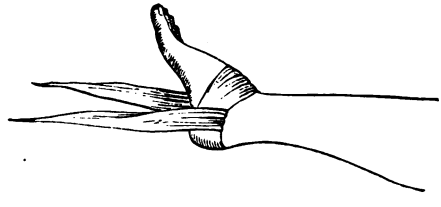
Very excellent cures may be effected, undoubtedly, by the use of this apparatus; but it is one which demands, in its employment, the greatest care and attention on the part of the attendant. There are some points to which the author would call particular notice: — the accidents chiefly to be feared, as directly connected with the use of this splint, are, excoriations and sloughs upon the heel, on the inner side of the knee, at the prominence of the inner condyle of the femur and the corresponding point of the tibia, and in the perineum. These are not necessary accompaniments of the mode of treatment now under consideration, and with proper care they will never occur; but without great watchfulness they are exceedingly likely to happen; they may be avoided in this way:—

The gaiter should be unbound daily, so long as it is worn, and the instep, ankles, and heel carefully examined. During the first week, or ten days, the gaiter should be loosened every morning and evening, and these parts bathed with whiskey, or soap-liniment; this may be done without in the slightest degree deranging the fragments of bone, simply by turning up the lower ends of the junk-bags, so as to give room for the introduction of the hand between the splint and the foot, — the strips which maintain the lateral pressure being securely tightened. The inner side of the knee should be gently rubbed in the same way, and a little indentation should be made in the junk-bag, corresponding with the bony prominences of the femur and tibia at this point. The perineal band should be loosened daily, — the limb being supported the while by an assistant, and the lateral compression maintained, — and the parts upon which it presses bathed, as the others. Whenever the apparatus is thus re-adjusted, renewed extension and counter-extension should be made, and in order that this may be persevered in until the end of the treatment, it is highly necessary that the splints shall be so

closely wrapped in the cloth, and shall approach the limb, on each side, so nearly, as that firm lateral pressure may be kept up, and thus the strain upon the foot and perineum rendered very supportable.

It is advisable, oftentimes, to vary the means by which the extension and counter-extension are effected. Thus, after having used a perineal band of the dimensions and form above recommended, let one be substituted flattened in shape and broader, so as to act upon a larger surface, and thus relieve that part which has been already pressed upon. So with regard to the gaiter, — it will occasionally, perhaps, be well to substitute for this a handkerchief folded into the cravat-shape, and applied so as to press upon the instep and the point of the heel, the tails passing from the sides of the foot, parallel with the axis of the limb, and reaching to the extremity of the long splint upon which they are tied. (See fig. 71.) Another mode of making extension is by means of adhesive plaster, as follows:—Cut two very long strips, of an inch, or more, in width, and apply them to the leg, commencing at a point halfway between the foot and the knee, descending spirally to the side of the foot, one on each side: then, when adhesion between the strip and the integuments has become firm, attach the strips to the extremity of the long splint, as by the other method. This plan was first employed by Dr. E. Wallace, of this city, while Resident Surgeon at the Hospital; he used it as a substitute for the gaiter, which had produced excoriation just above the heel; the author had the pleasure of witnessing the complete success which attended the operation of this novel extending band, both in the instance in which it was first tried and in several other cases, and he would recommend it highly, as being perfectly secure and efficacious. It may be proper to make use of a few turns of a roller, or of a bandage of Scultetus, to compress the adhesive strips against the leg, but this is scarcely called for,

Fig. 71.



since the junk-bags exercise sufficient pressure of themselves.[1]

If there is any disposition to excoriation or sloughing upon the points of the malleoli, pressure should be taken off from them, by not allowing the junk-bags to extend so low down. The same accident may be prevented from occurring upon the point of the heel by placing a cushion just above it, under the leg, so that the weight of the limb shall not fall upon this point. The same simple method may be resorted to when a similar accident threatens the hips or back, — a judicious arrangement of pillows will often obviate much mischief, aided also by stimulating liniments applied to the parts. When, in spite of these precautions, sloughing does occur — as it sometimes will in old persons, or in those of lax fibre, — all pressure should be at once withdrawn from the affected surface, and the separation of the dead tissue aided by the application of poultices; afterwards stimulating washes should be used, among the best of which is Labarraque's solution of the chloride of soda, diluted with three or four parts of water, and applied to the ulcer upon rags, or, if the slough has extended beneath the skin, injected from a syringe.

There is one objection to the employment of this apparatus of Desault and Physick in the treatment of fractures of the thigh, occurring particularly in the upper third of the shaft — (and the same objection is applicable to the treatment by extension in the straight position, generally): it is sometimes impossible to counteract, by it, the deformity which arises from the powerful contraction of the iliacus internus and psoas magnus muscles, which tilt up the lower end of the upper

[1] I am greatly indebted to the kindness of Dr. Gross, the distinguished professor of surgery at Louisville, for the knowledge of the fact that this application of adhesive plaster was originally made more than twenty years ago, by Dr. Swift, of Easton.

In his treatise on "the Anatomy, Physiology, and Diseases of the Bones and Joints" (Philadelphia, 1830, p. 50), Dr. Gross points out the reasons which led Dr. Swift to suggest this means of making extension: they are precisely those which induced Dr. Wallace to resort to this expedient. Dr. Wallace, I am sure, had no knowledge that any one had previously recommended or employed the adhesive plaster for this purpose.

Latterly, the employment of adhesive strips has been very much extended to the treatment of many other fractures; as by Dr. Crosby, to fracture of the clavicle. (New York Journal of Medicine, 1851.)

fragment. When this action is but slight it may be overcome, gradually, by compression with a splint bound upon the anterior face of the thigh, or by a compress, or, finally, by a little elevation given to the lower fragment by means of a folded sheet placed beneath the thigh, at this point. But in very athletic patients the muscles in question may contract too powerfully, and then these means will fail; if the straight splints are retained, a permanent deformity will ensue and the limb will be always weak, in consequence of the imperfect apposition of the fragments. In such cases as these, the double inclined plane should be substituted for the other apparatus.

The apparatus of Desault, improved as above described, is, we think, the best which has yet been contrived for the treatment of fractures of the thigh, in the extended position.

There are several other modifications of Desault's apparatus, less simple than the one which we have explained.

The late Dr. Hartshorne, of this city, invented one in which the long and the short splints are connected together by a transverse piece, through which a long wooden screw passes, having a foot-board attached to it.

Dr. T. H. Bache, lately resident Surgeon to the Pennsylvania Hospital, has modified Physick's apparatus as follows: A long, narrow fenestrum is cut in the *outer* splint, extending upwards from near its lower extremity; in this slides an iron arm, capable of being firmly fixed by screw-clamps at any point, so as virtually to lengthen or shorten the splint in adaptation to limbs of different length; through this arm passes a long screw, its axis being continuous with that of the limb when placed between the two splints, and to the upper or proximal end of the screw is attached a transverse piece of iron, having a hole pierced through each extremity. To apply this apparatus, the limb is placed between the two splints, and a counter-extending band and junk-bags are arranged just as in Physick's method; but the extending tapes or adhesive strips are secured to the transverse iron plate last spoken of, so that the elongation of the limb is accomplished by acting upon the screw which passes through the arm that is connected to the outer splint. The arrangement is very neat, and the apparatus light and strong. Its action is very well spoken of by the gentlemen who are attached to

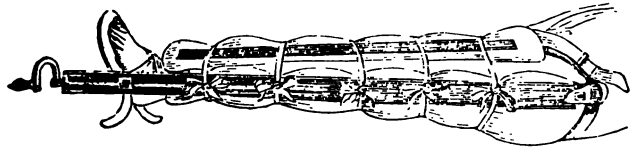
the Pennsylvania Hospital; it is believed by them that it effects elongation of the shortened limb more gradually than Physick's splint, and that it enables the surgeon to judge accurately whether or not he is really gaining in this particular.

I must confess that I should prefer the simpler apparatus of Dr. Physick. From having seen Dr. Bache's splint in use at the Hospital in two or three cases of fractured thigh, my impression is that the foot is not as securely and steadily held by this as by the other; and it appears to me that to make extension by the screw, rather than by the hands directly applied to the limb, is more likely to endanger excoriation of the foot. The stretching of the extending strips or tapes, under the force constantly acting upon them, will readily deceive any one who trusts to the mere operation of the screw to inform him as to the improvement in the length of the limb. Moreover, the simplicity of Physick's apparatus is in itself an advantage and a recommendation. Perhaps the splint of Dr. Bache might be improved by attaching to the screw a foot-piece, to which the foot should be immediately secured, instead of having a simple transverse piece.

Boyer's apparatus is composed of a long splint for the external side of the limb, with a movable foot-board connected therewith; of two straight splints for the anterior and inner faces of the limb; a belt enclosing the upper part of the thigh and the groin, and giving a "point d'appui" to the upper extremity of the outer splint; straps to secure the foot to the foot-board; cushions, and tapes to confine the apparatus upon the limb. The outer splint is the only complicated part of the apparatus. It is about four feet long and as many inches in width; from its lower extremity upwards, along about half its length, runs a groove in which a screw plays; the upper end of the screw turns upon an iron plate, while the other extremity, at the end of the splint, has a key attached to it, by which it is made to revolve. A foot-piece, made of iron, and padded, is connected with the screw, upon the inner side of the splint, and is moved nearer to, or farther from, the lower extremity of the latter by revolutions of the screw, so as to make the necessary extension, while the upper end of the splint fits into a little pouch upon the thigh-strap, thus effecting the counter-extension: the foot-

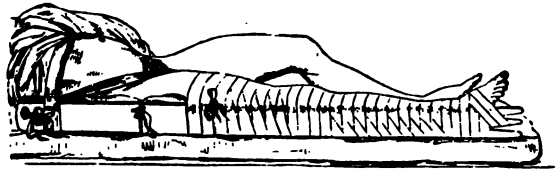
piece has two legs upon which it rests. In the application of this apparatus the foot is attached to the iron plate; the upper end of the splint is inserted into the pocket of the thigh-belt, which has been previously passed around the upper part of the thigh and groin; a long pad protects the limb from contact with the outer splint, and equalizes the pressure from it; then, after the reduction of the fracture, the inner and anterior splints, well padded, are placed upon the thigh, and the whole is secured by means of several bands, as shown in the figure. (See fig. 72.) As much extension as the surgeon thinks necessary is made by turning the screw, thus drawing down the foot, and with it, of course, the lower fragment of the broken femur.

Fig. 72.



Mr. Liston recommends the employment of a single straight splint of deal-board, long enough to extend from opposite the nipple to three or four inches beyond the foot; near its upper end two holes are bored, and the lower extremity is notched, while just above the latter is a perforation large enough to accommodate the malleolus; the splint is covered on its inner face by a cushion. The leg is bandaged

Fig. 73.



from the toes nearly to the seat of fracture, before the splint is applied: then the fracture is reduced, and the perineal

band—made as for Desault's apparatus—is tied to the upper end of the splint, to which the whole limb and the side of the body are now confined by means of a roller, — several turns being passed around the foot, and gaining support from the notches made in the lower end of the splint. (Liston's Pract. Surg.) (See fig. 73.)

Drs. Kimball and Sanborn, of Lowell, Mass., have contrived a single splint for the treatment of fractures of the thigh, which is figured in Miller's Practice of Surgery. (Fig. 74.)

Fig. 74.



It extends from the axilla to below the foot, but is so contrived as to be capable of being lengthened at each extremity. The upper end terminates in the manner of a crutch; the lower has a sliding bar fitted to it, upon which a transverse arm is secured at right-angles. In using this splint, "two long pieces of strong adhesive strap are applied, one on each side of the limb, extending from above the knee to the ankle, and these are secured by a roller. The end of each strap is uncovered with adhesive matter, and hangs loose from the foot. The ends of each strap are secured to the cross-bar at the splint's extremity, and the limb is made one with the splint in the ordinary way. By turning the screw, the cross-bar is moved up or down, at will, and extension consequently is regulated with both accuracy and power. The perineal band is employed besides, but should its pressure prove at any time galling, it may be temporarily discontinued with safety, the crutch of the splint being moved up into the axilla, to supply its place." (Miller's Practice, p. 652.)

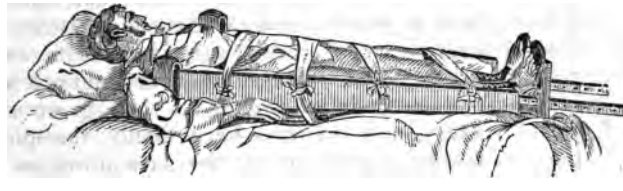
We do not see that the screw-extension power is of much advantage, and we can by no means advise any one to dispense with the perineal counter-extending band, because the axilla does not offer a fixed point of resistance. And, moreover, it is impossible to preserve the proper shape and direction of the limb if only one splint is used.

The same objection is applicable to the original splint of Hagedorn, which consists of a single long splint and a footboard, the latter being broad enough to support both feet, and moving up and down, but capable of being secured at any point upon the splint.

Dr. Gibson, Professor of Surgery in the University of Pennsylvania, has introduced a modification of Hagedorn's apparatus, which he thus describes — ("Institutes and Practice of Surgery," vol. i.):—"This method consists in extending the patient's limbs upon a mattrass, and confining both feet, by gaiters, or a handkerchief, to a footboard which is firmly supported upon the ends of two splints passed through mortices near its edges. These splints extend from the armpit, where they are padded like the head of a crutch, along each side of the body, thigh and leg, beyond the foot, and, being well stuffed on their inner surfaces to prevent irritation, are confined by six or eight broad tapes or bandages passed around the limbs, pelvis, chest, &c. (See fig. 75.)

"The principle upon which extension and counter-extension are effected by this contrivance, will instantly be understood. The sound limb being extended, serves as a splint to the bro-

Fig. 75.



ken one. Counter-extension then is made upon the *acetabulum* of *the sound side*, and extension upon the ankle of the injured limb, which, so long as the two feet are kept on the same level, cannot be shortened, provided rotation of the pelvis be prevented. This purpose is answered by extending the splints to the arm-pits, and not with a view, as might be supposed, of producing counter-extension from these points. Finding that the patient, in the original machine of Hagedorn, could incline the pelvis towards the affected side, and

thereby shorten the limb, by causing the superior fragment to descend and overlap the inferior, the additional splint was added, and has been found to answer completely the end designed."

During my residence in the Pennsylvania Hospital, I had the opportunity of testing the efficacy of this apparatus, in two cases of fracture of the thigh,—one in a child, the other in an adult. In both instances, the result was as satisfactory as I have ever seen to follow the employment of any other method: I was led to make use of this apparatus, because the skin about the ankle and perineum of the child was so very tender, as to render the pressure upon these parts, from the gaiter and counter-extending band of Desault's apparatus, insupportable, and, moreover, he was not sufficiently restrained by this last-mentioned apparatus; — and because, in the instance of the man, the whole instep was much bruised by the same fall which caused the fracture of the thigh. The plan which I adopted was the following: — A straight splint was first confined to the under surface of the sound limb, to prevent flexion of the knee; the splints were then placed on each side of the patient; the sound foot was secured to the foot-board; long pads protected the outer sides of the limbs from contact with the boards; the fractured thigh was brought to the same length as the other, and the foot bandaged to the foot-board; a firm junk-bag was now inserted between the limbs along their whole length, so that the injured limb should be supported at every point by the other, and several wide strips of muslin were made to enclose in their grasp each thigh, with its splint and the junk-bag; finally, the splints above the pelvis were pressed against the patient's sides, by means of muslin bands, and in the same manner lateral pressure was effected upon the whole apparatus.

The management of this apparatus requires great attention; its confinement is very irksome to the patient, as it imprisons both limbs. It is particularly troublesome, when he has an evacuation of the bowels to effect, because he cannot assist himself, nor the attendant, with the sound leg; when it is employed, therefore, a clinical frame, such as has been described, should be used instead of an ordinary fracture-bed, or the fracture-bed herein described, will be found serviceable and convenient.

The same care as when the other splints are resorted to, is requisite, with regard to the prevention of injury to the parts of the integuments pressed upon, as the heel, ankles, hips, &c.

It is proper to mention that, in the man upon whom this apparatus of Dr. Gibson was tried, the fracture was at the lower third of the femur, and that the thigh was not a very muscular one. Whether a sufficient degree of extension can be accomplished by it, to maintain in coaptation the fragments of a thigh-bone, when the muscles of the limb are fully developed, and when the fracture is higher up, within the operation of the glutæus muscle, the author cannot affirm; he has a sufficiently good opinion of the apparatus, however, to be induced to use it again.

In fractures of the shaft occurring in young children, the method recommended by Mr. Liston, as before described, with the addition of curved splints for the anterior, posterior, and inner surfaces of the thigh, is the most convenient and the best plan of treatment. The naturally slightly curved shape of the bone should be recollected, and this conformation should be secured by the proper use of compresses.

2. For fractures of the thigh at its upper extremity.

The general principles of treatment in these cases are the same as when the shaft is broken; but there are some anatomical and physiological peculiarities of the pelvic extremity of the os femoris, which require corresponding modifications of treatment, when this part of the bone is ruptured.

When the fracture occurs within the capsular ligament of the joint, bony union, according to the best authorities, is at least exceedingly improbable, though not impossible. (See Sir A. Cooper, Cruvelhier, R. W. Smith, &c.) The accident happens, moreover, for the most part, to persons advanced in life and incapable of supporting long confinement in bed in any one position. Concerning the treatment of these cases, Sir A. Cooper makes the following remarks: — "I would prefer a ligamentous union to the confinement and danger of bony union, in regard to the health and life of the person, and, as I believe, to the subsequent use of the joint. Baffled in our various attempts to cure these cases, and finding the life of the patient occasionally sacrificed under the trials made to procure bony union, I should, if I sustained

this accident in my own person, direct that a pillow should be placed under the limb throughout its length; that another should be rolled up under the knee, and that the limb should be thus extended until the inflammation and pain had subsided. I should then daily rise and sit in a high chair, to prevent a degree of flexion which would be painful; and, walking with crutches, bear gently on the foot at first, then, gradually more and more, until the ligament of union had become thickened, and the muscles increased in their power. A high-heeled shoe should be next worn, by which the halt would be much diminished. Our hospital patients, treated after this manner, are allowed in a few weeks to walk with crutches; after a time a stick is substituted, and in a few months they are able to use the limb without any adventitious support." (Sir A. Cooper, op. cit., p. 142.)

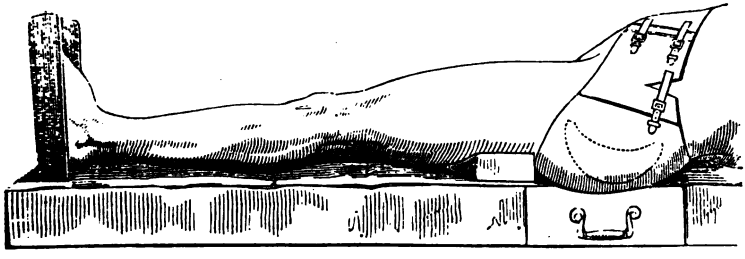
When the solution of continuity has occurred partly within and partly without the capsular ligament, or through the great trochanter, the displacement is less, and it is more easily obviated. The limb should be kept in the extended position, by any of the methods which have been described, and the outer splint should be pretty firmly pressed against the trochanter and the side of the body by a circular bandage. The apparatus of Dr. Gibson would answer admirably in these cases.

If the trochanter major be merely severed from the root of the neck, the axis of the bone not being involved, there is no shortening of the limb, and the treatment of the accident is very simple. The patient should be kept upon his back, with the limb in the extended position, and rendered incapable of flexion at the knee and thigh by means of a well-padded splint, extending from above the tuberosity of the ischium to near the heel, and secured thus by rollers; in addition, a broad band should be passed around the pelvis, to compress the fragment of the trochanter upon its place.

The annexed wood-cut illustrates a method pursued by Sir A. Cooper, in the treatment of this injury. The patient is lying upon a fracture-mattrass, to the foot of which is attached an upright support for the sole of the foot; a broad band grasps the trochanter and presses it upon its natural seat. (See fig. 76.)

3. For fractures at the lower extremity of the femur.

Fig. 76



The thigh-bone may be broken transversely just above the condyles, or obliquely, or the fracture may extend through the condyloid expansion into the joint.

In the first case, there is oftentimes no displacement, or if the axis of the limb has been deranged, the fragments, after reduction, are easily retained in apposition by lateral compression and rest in the extended position.

When, however, the fracture extends obliquely from behind forwards and downwards, as is usually its line of direction, or even from before backwards and downwards, the powerful muscles which descend from the pelvis act with great energy upon the lower fragment, and draw it upwards, leaving the extremity of the upper fragment, in the first-mentioned variety, projecting anteriorly and penetrating the rectus muscle, sometimes perforating the integuments even. The treatment of this injury consists in keeping up strong extension and counter-extension in the straight position, and in making as firm compression upon the fragments, when reduced, as the condition of the parts will allow, aided generally by evaporating lotions, leeching, &c., &c. After the lapse of three or four weeks, passive motion should be commenced cautiously and persisted in. (Sir A. Cooper.)

Others advise that the limb should be secured upon the double inclined plane, the foot being well supported. They urge in favour of this position, that it relaxes the muscles which act so powerfully upon the lower fragment, and thus renders sufficient a less degree of extension upon the inflamed joint, while the mere pressure of the under surface of the limb upon the plane counteracts in a great measure the retraction of the lower fragment.

A strong argument in favour of the straight position is that, if anchylosis should occur, the limb is in a much more desirable position than if the double inclined plane is employed.

When one of the condyles is separated from its connexion with the lower portion of the femur, the extended position is certainly the most favourable one for the relief of the accident. A piece of pasteboard, large enough to inclose the posterior two-thirds of the joint, and notched along its margins to enable it to adapt itself better to the form of the part, should be softened in hot water and then moulded about the posterior face of the knee, and secured thus by means of a roller; Desault's apparatus, or a single straight splint for the under surface of the limb, will complete the necessary confining means.

4. For compound fractures of the thigh, the same general principles of treatment exist as for the simple: the accident should be converted into a simple fracture, if practicable, by immediate closure of the wound; and during the whole progress of the case, the natural conformation and length of the limb should be preserved, as far as possible. It must be borne in mind, however, that some degree of shortening will occur almost of necessity, in consequence of necrosis of the broken extremities of the bone, and because, from the nature of the injury, the same degree of extension and of lateral compression cannot be maintained as in cases of simple fracture.

The limb may be placed in the flexed position on a double inclined plane, or it may be extended by means of any of the different sorts of apparatus already described, or, finally, it may be placed in a long fracture-box, the sides of which are connected by hinges with the bottom piece, and extend, on the outer side to the axilla, and on the inner to the pelvis, the foot being secured to a perpendicular plane attached to the lower extremity of the bottom-piece. In this box, the limb may repose upon a bed of bran, which also affords the necessary lateral pressure when the sides of the box are closed. Probably, if the fracture be seated in the vicinity of the middle of the bone, it can be treated as well in Physick's apparatus as in any other. Either of the splints can be bracketted opposite the point of injury, as is represented

in the accompanying drawing from Mr. Erichsen's Treatise, in which Mr. Liston's splint is thus arranged. (Fig. 77.)

Fig. 77.



The bandage of Scultetus is, as in other compound fractures, the best compressing bandage, as it admits of removal and adjustment without disturbing the limb. The wound itself should be uncovered, excepting by a poultice, or some similar dressing, so that the matter may have free escape, and this should be aided by moderate pressure upon the thigh, above and below the wound, effected by the bandage, which should be made to act with particular care on any point or points beneath which the matter may be disposed to collect: if an abscess should form at any point remote from the wound, as happens in almost every compound fracture, it should be opened by the knife.

The dressing for the wound must be varied to suit its appearance at different times. Great cleanliness of the parts, and also of the dressings, should be observed.

The great length of time during which it is necessary to confine the patient to bed renders it advisable to resort to every expedient to prevent sloughing; besides the frictions heretofore recommended in compound fractures, the position of the patient should be changed, from time to time, as far as may be consistent with the security of the limb; the use of the inclined plane, for example, may be alternated with that of the straight splints.

When the condition of the wound will allow of more direct compression being exercised about the seat of fracture, this means should be instituted as an aid in securing a proper shape to the thigh. For this purpose, strips of adhesive plaster, or of soap plaster, may be employed,—while the roller, or the

bandage of Scultetus, cannot be used,—an interval being left between the strips, for the ready escape of the pus.

SECTION II.

ON THE APPARATUS AND DRESSINGS FOR FRACTURES OF THE PATELLA.

The patella may be broken longitudinally, or transversely.

1. Longitudinal fractures of this bone are attended with little or no displacement of the fragments, as a general rule; hence the probability of perfect reunion by bony matter is great, and the treatment is very simple. The leg should be extended upon the thigh, and the thigh flexed to a moderate degree upon the pelvis, while a roller is passed around the limb, from the toes to the upper part of the thigh, being made to exercise considerable lateral pressure upon the fragments of the patella, by means of compresses placed at each side of the bone. The limb should be laid on a simple inclined plane, and, for the sake of greater security, a splint should be bound to its under surface. The application of these retentive means should be preceded, if there be much inflammation about the joint, by leeching; and after the bandage is applied, cold lotions may be employed, if required.

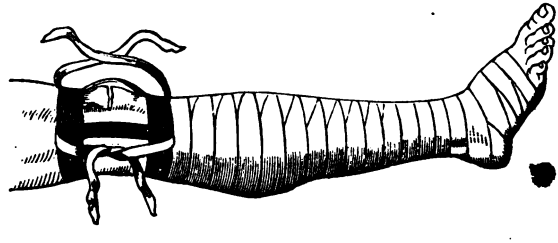
2. When the fracture has assumed a transverse direction, a considerable degree of separation of the fragments is unavoidable, the retraction of the upper portion varying from one to three or four inches, according to the power of the extensor muscles which are connected with the base of the patella, and to the position in which the limb has remained after the injury.

A variety of mechanical contrivances have been resorted to, to remedy the effects of this accident and to maintain the fragments in apposition. The bond of union is usually ligamentous, so commonly that Pibrac offered a prize of one hundred *louis d'or* to any one who would show him a specimen of transverse fracture of the patella cured by bony union. Specimens of this mode of healing do, however, exist. But it must be borne in mind by the surgeon that, although a very good ap-

position may have been gained and retained during the treatment, the ligament of union almost invariably becomes elongated after the patient commences to use the limb, even when a splint has been bandaged to its under surface and worn thus for a long time after confinement to bed has ceased. This fact should always be impressed upon the patient and his friends, as otherwise the surgeon may suffer in reputation.

The treatment recommended by Sir A. Cooper is, that the limb be lightly bandaged to a straight splint placed all along the under surface of the limb, the knee being left entirely uncovered; that the extensor muscles of the leg be relaxed by elevating the limb upon an inclined plane, while the trunk is flexed upon the pelvis, and that local antiphlogistic remedies be applied upon the joint, until inflammation shall have ceased. Then "a roller is applied from the foot to the knee, to prevent the swelling of the leg, and the upper portion of the patella is pressed downwards towards the lower, as far as it can be without violence, so as to produce the approximation of the fragments. Rollers are applied above and below the joint, confining a piece of broad tape next the skin on each side, which crosses the rollers at right angles; these tapes are next bent down and tied over the rollers, so as to bring the latter near to each other, and thus to keep down the upper portion of bone. Sometimes, instead of the tape on each side, a broad piece of linen is bent over the rollers on the fore part of the joint, and is there confined, so as to approximate the portions of bone and to bind down the upper fragment of the patella, that its lower broken edge may not turn forwards." (Op. cit. p. 205.) (See fig. 78.)

Fig. 78.



Another method recommended by the same high authority

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is the following:—A leathern strap may be buckled around the lower part of the thigh, above the broken and retracted fragment of bone; from this circular band another strap should be passed along the side of the leg across the sole of the foot, the leg being extended and the foot flexed as much as possible. This strap is then carried up along the other side of the leg, and buckled to that which has been fixed around the thigh; it may be confined to the foot by a tape tied to it, and to the leg, at any part, in the same manner. This is a very convenient bandage for the fractured patella, and for the patella dislocated upwards by the laceration of its ligament. A roller is to be applied around the leg. (Op. cit. p. 205.) (See fig. 79.)

Fig. 79.



M. Desault directed that the limb should be held in the position above advised, by an assistant, and a roller passed around the leg from the toes to the knee, confining on the front of the leg a band about two inches wide and of the length of the limb; then that two longitudinal slits be made in this band, opposite the patella, through which the surgeon passes two fingers and approximates the fragments: that a compress be applied just above the upper fragment and retained there by several turns of the roller passing around the knee in the form of the figure 8; the bandage now should cover the thigh, a padded splint, as long as the limb, should be confined upon its under surface, and the whole supported on an inclined plane.

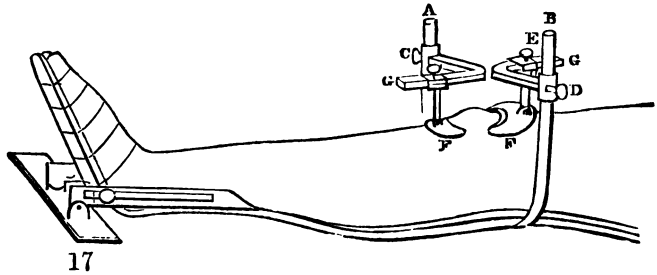
M. Gerdy employs an invaginated bandage, such as is used in the approximation of the lips of transverse wounds. (See chap. on Wounds.) The leg, as high as the knee, is enveloped by a roller, which also confines upon the front of the leg the tailed portion of the bandage, the slit portion being secured upon the front of the thigh by a second roller; then, having

placed a compress above the upper fragment, and another below the inferior, pass the tails of the bandage through the slits, and approximate the fragments; this having been effected, lay the portions of the bandage smoothly along the limb, and secure them by turns of a roller.

Mr. Amesbury has invented an apparatus consisting of two wide leathern pads, to be placed one on the anterior face of the thigh above the knee, the other on the leg below the knee, and attached to each other by straps and buckles. In order to compress the extensor muscles of the leg, and at the same time to avoid unnecessary constriction of the limb, these pads are secured by means of straps and buckles, to a splint placed on the under surface of the member, with a foot-board attached, and made sufficiently wide, opposite the knee, to project a little beyond it upon each side. The upper pad, and with it the corresponding fragment of the patella, is made to approximate the lower by means of a strap, which passes from the lower edge of the upper pad, along the side of the leg, and across the foot-board, to ascend on the other side of the leg and be buckled to the pad. (Amesbury, vol. ii. p. 492, &c.)

Mr. Lonsdale has contrived an instrument, which he has found very efficacious in the treatment of this fracture. It consists of a splint upon which the limb reposes, and to which a foot-piece is attached in such a way as to be movable up and down, to accommodate the splint to limbs of different lengths; to the under surface of this splint two vertical iron bars are connected, A B, (see fig. 80,) at about its centre, each one supporting a horizontal arm bent at right angles, G G; these horizontal pieces slide upon the upright staffs, but

Fig. 80.



can be arrested at any point by the screws, C D; from these arms depend other vertical rods, movable upon the former, and, like them, fixable by similar screws, E; finally, to the lower end of each of these second perpendicular rods, an iron plate, F, F, of a horse-shoe form, is attached, by means of a hinge-joint. In the application of this apparatus, the splint should be well padded, and the foot and leg secured to it by a roller, a bandage having been first passed around these parts; then the surgeon places the fragments of the patella in juxtaposition, the muscles being relaxed as before directed, and applies the upper horse-shoe plate to the upper part of the thigh, a soft pad intervening, just above the superior fragment, — not touching the patella itself, while the other plate is applied just below the inferior fragment; the plates are secured in these relations by means of the screws, and a roller is passed around the thigh and the upper part of the splint. The limb is retained during the treatment in the same position as in the other modes already described.

Mr. Lonsdale states the advantages of this apparatus to be, that it may be applied immediately after the fracture occurs, that it produces no constriction of the limb, and that it leaves the injured part exposed to the inspection of the surgeon during the whole course of the treatment, and allows of the application of antiphlogistic remedies; he has found it to answer the purpose for which it was intended, in a very satisfactory degree. (Op. cit., p. 427, &c.)

Mr. Fergusson describes a very simple and neat apparatus, contrived by Mr. John Wood, for the treatment of this injury. It consists of a splint extending from the pelvis to the sole of the foot, hollowed to receive the limb, and a foot-piece attached; the lower extremity of the splint rests upon a block, so that when applied, the plane upon which the member reposes, is inclined. The limb is confined upon the splint by means of rollers, the fragments of the patella being retained in apposition by a few turns after the manner of the figure 8, and to prevent these latter turns of the roller from slipping, two hooks are screwed into each side of the splint, above and below the position of the knee, around which the bandage passes. (Fig. 81.)

The apparatus of Boyer, of Dorsey, Mogridge, and others,

Fig. 81.



offer no particular advantages above those which have been described.

M. Malgaigne, in his excellent "Traité des Fractures, p. 764, states, that he has seen M. Gama, surgeon to the military hospital of Val de Grace, treat successfully cases of transverse fracture of the patella, by means of strips of adhesive plaster passed above and below the fracture, in the form of the figure 8, the limb being placed upon the simple inclined plane. And in the Philadelphia Medical Examiner, p. 5, Jan., 1854, Dr. John Neill reports two cases of this injury in which this method was pursued. It is, undoubtedly, the simplest and the best plan which can be resorted to.

After the limb has been thus confined for six or eight weeks, passive motion should be commenced and practised cautiously but diligently; in the course of two weeks' longer time, the patient may be permitted to bear moderately upon the foot in walking, a splint being bound to the under surface of the limb; he should step on the sole of the foot flatly, and not on the toe; the splint should be worn thus, for a few weeks.

3. Rupture of the tendon, and of the ligament of the patella should be treated in the same manner as if the bone itself were broken.

4. Compound fractures of the patella require the same general principles of treatment as the simple forms. But in addition to the injury done to the bone, that which is inflicted upon the soft parts and on the joint demands attention, and modifies the treatment. The indications are, to close the wound immediately, in the hope that it will heal without being accompanied by violent constitutional disturbance, and to

retain the fragments of the patella in as close apposition as the condition of the parts will permit. The limb must be placed upon a splint in the same position as directed for simple fracture, the body being well supported in the flexed position on the pelvis, by pillows arranged behind the back. The lips of the wound, after all foreign matter has been removed from the opened joint, should be drawn together by strips of adhesive plaster, which strips may be so applied as to draw down the upper fragment of the patella, and to retain it in apposition with the lower: then a piece of lint should be dipped in the blood which flows from the part, or in some adhesive and glutinous fluid, and laid upon the wound, where it should be retained by a light bandage; all pressure being avoided upon the joint itself, the muscles of the thigh may be moderately compressed by a roller, the same which confines the splint upon the limb. Thus arranged, the dressing should not be disturbed so long as no unpleasant symptom arises; such as severe inflammation, free suppuration, &c. In a case recorded by Sir A. Cooper (op. cit., p. 210, 11), the first applications were not removed until a month after the accident, when the wound was found nearly healed; the patient in this case recovered with a perfectly useful limb.

The author treated in this manner, at the hospital, a case of compound fracture of the patella, produced by a kick from a horse, in which a similarly happy cure followed. If, however, violent inflammation follows the injury, with profuse discharge and much constitutional suffering, the primary dressing must be at once removed, and antiphlogistic remedies resorted to, — as local and general depletion, poultices, or water-dressings, &c., &c. Passive motion should be cautiously instituted as soon as circumstances will admit of it. The introduction of sutures should be avoided as much as possible; if employed, care should be exercised not to include the ligament in the suture. (Sir A. Cooper, op. cit., case 137, p. 210.)

SECTION III.

FOR FRACTURES OF THE BONES OF THE LEG.

Like those of the fore-arm, the two bones of the leg may be broken at the same time, or each may be fractured separately.

1. When both the tibia and fibula are broken, the maximum degree of displacement is produced, partly by the violence causing the fracture, and partly by the action of the powerful muscles situated about the leg. The line of fracture is generally oblique, in almost any direction, and this direction influences the course of displacement which the lower fragment assumes. When the solution of continuity of the fibres of the bone is in a transverse direction, there is often no shortening of the leg, but merely a lateral derangement; when, however, the fracture is oblique, there is both lateral deformity and shortening; in the former injury, the fragments are easily retained in apposition, after reduction, by rest alone; in the latter, a continued confining apparatus is necessary to counteract the disposition on the part of the muscles to contract and to draw upwards the inferior portion of the bones. Generally, a moderate degree of mechanical force, with the limb in the straight position, suffices for the successful treatment of simple fractures of the leg; there are instances, however, in which, from the powerful action of the muscles and the direction of the line of fracture, such deformity is produced that it becomes desirable to take advantage of the effect of position to aid the treatment, as in fractures of the thigh.

The simplest plan of treatment by mechanical means, consists in the employment of the "junks;"—these are generally made of pieces of wood, or of bags of straw, or chaff, rolled firmly in a splint cloth, and long enough to extend from the lower third of the thigh to below the ankle, on each side of the limb. In the application of this apparatus, the junks thus rolled are glided underneath the leg upon a pillow, which supports the whole leg and the heel; the fracture is reduced, and the mechanical supports brought in contact on each side with the knee and the ankle, all the intermediate parts of the leg being likewise apposed to the lateral supports, either

directly, or through the intervention of compresses of cotton, or tow; the whole is secured thus by strips of muslin passed around the junks.

This apparatus leaves the anterior face of the leg exposed to the examination of the surgeon and to the action of local applications, while at the same time it exerts a sufficiently powerful lateral compression upon the leg, to retain in apposition the fragments of the bones, in all cases of transverse fracture, and in many, or most, of the oblique. It does not, however, offer so great a degree of security against sudden, or accidental, movements of the limb, as another apparatus, which is almost as simple as itself,—the fracture-box, of which mention will be made directly.

Many different kinds of splints have been contrived at various times, and by different surgeons, for the treatment of these injuries. The best have all sought to give support to the inferior surface of the leg and the foot, and also to exert more or less lateral compression. Thus the splints of Mr. Neville, highly recommended by Mr. Lonsdale and others, consist of a light iron piece padded, for the inferior face of the leg, extending from the lower part of the thigh to the foot, at which point it curves upwards, to form a support for the sole of the latter,—and of two lateral splints, of the same length as the other, and also padded, and secured to the sides of the foot-piece by a mortice-and-pinion joint; circular strips of muslin complete the apparatus.

The fracture-box, however, combines all the advantages of these with many others which these do not possess, as greater simplicity of construction, and in consisting of but a single piece, as it were, by which greater solidity is gained. It is composed of a horizontal plane of board extending from a little above the knee to the sole of the foot, where a piece, rather longer than the foot, and of the same width as the other plane, is firmly secured to it at right angles: side-pieces, also made of wood, six or seven inches wide, and of the same length as the bottom-piece, are connected with the latter by hinges. (Fig. 82.) To apply this apparatus to the treatment of fractures of the leg, open the sides of the box, and place a pillow upon it, soft enough to adapt itself well to the inequalities of the leg; then, having reduced the fracture, secure the foot to the foot-board by a strip of bandage, and

close the sides of the box, more or less tightly, according to the condition of the limb and the degree of pressure requisite to retain the fragments of the bones in apposition; the sides are thus secured by strips of muslin. If the pillow alone is insufficient to exert the requisite pressure, compresses should be used in addition, and these should be so placed as that the pressure may bear upon those particular points where they are most needed. Thus the proper shape of the limb may be easily preserved, being made more or less curved by the action of the pillow and compresses. In this manner, some of the most marked deformities may be obviated. Thus, for example, in treating the fracture of which the annexed drawing from Fergusson's Practical Surgery (Am. ed., p. 304) illustrates the appearance, the leg should be placed in the fracture-box, as above directed, and a compress be applied upon the tibial side of the limb, just above the prominence of bone, while another is laid on the fibular side, a little below the seat of fracture; the compression exercised upon these points, when the sides of the box are closed, will suffice to restore the leg to its proper shape, and to retain the fragments in complete apposition. (Fig. 83.)

Fig. 82.

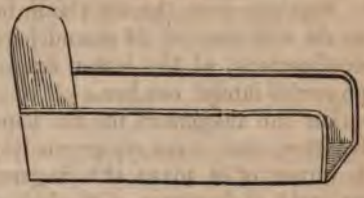


Fig. 83.



The shape of the sound leg should be compared daily with that of the broken one, and any deviation from the proper line in the latter should be rectified in the manner pointed out. The foot should be kept upright against the foot-board, the heel supported by the pillow, and an additional pad, if necessary. If there be any signs of excoriation or sloughing on the heel, or malleoli, pressure should be immediately

removed from these points, and brought to bear upon others, and the surface protected by simple cerate, or stimulated by frictions with spirits of camphor, soap liniment, &c., &c. Care is requisite lest the foot fall below its proper line, as compared with that of the sound leg; to obviate this liability to displacement of the lower fragment, a pad of cotton should be placed under the heel.

The advantages of the fracture-box are evident: it is perfectly secure; very simple in its construction; fully capable of retaining in place the fragments of the bones, in the vast majority of fractures of the leg, and it leaves the limb always open to inspection, and for the application of local remedies. In very many cases of this fracture, it is necessary or advisable to employ sedative lotions; one of the best of these is the solution of the acetate of lead; an objection to this, however, is that in many persons it irritates the skin too much, and in all it is apt to leave a deposition of the salt upon the surface, which is sometimes the source of irritation. When any liquid application is made, or any other dressing which may soil the pillow, a piece of soft oil-cloth should be spread upon the latter, before the leg is placed in the box.

The fracture-box may be rendered more perfect by placing brackets in each side, through which pieces of iron-wire shall be passed, arching over the box to protect the limb from the pressure of the bed-clothes.

Very often, indeed, in fractures of the leg, the skin will be found, in the course of a day or two after the accident, covered with small vesicles, particularly near the seat of the injury. This appearance, in persons of ordinarily good constitutions, is a matter of no importance, being indicative merely of a certain degree of irritation of the skin, which soon subsides under the application of cold water, and often it disappears if no local means are used; but the same appearance in persons of bad constitution, especially in habitual drunkards, is frequently the precursor of erysipelas or mortification, and should be carefully watched.

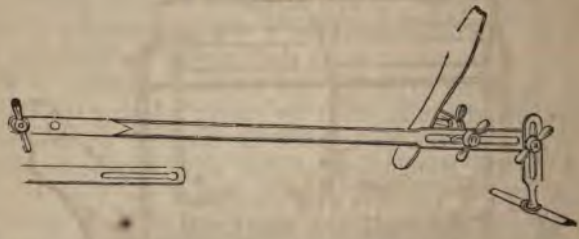
The most troublesome simple fracture of the leg is that in which the tibia has been broken obliquely, the line of fracture extending downwards and forwards. Here the powerful muscles of the posterior surface of the leg draw the inferior fragment upwards, leaving the sharp extremity of the upper

part of the bone projecting against the skin, and threatening to produce ulceration of the integuments at this point. Where this action of the muscles is but slight, the fracture-box may be employed, care being had that the inferior fragment, at the seat of the injury, is well supported by a compress placed beneath it. In other instances it will be necessary to adopt some plan of treatment which shall oppose the muscular contraction by direct extension and counter-extension, or which shall produce the same effect by simply relaxing the muscles in question. If the first mode be resorted to, the splints advised by Dr. Hutchinson, of this city, may be employed. They are two in number, extending from the knee to some inches beyond the foot; the upper end of each splint has perforations made in it, for the attachment of the counter-extending bands, and at the lower extremity of each is a mortise, through which a bar is passed. The leg is laid upon a pillow, upon which a bandage of Scultetus is arranged; tapes are secured upon each side of the leg, just below the knee, by means of a roller, and a gaiter, or a cravat, is fastened to the foot and ankle; then the fracture having been reduced, the leg is supported by an assistant, and the bandage of Scultetus folded upon it; the splints are now placed by the sides of the leg, pads intervening, the counter-extending bands are fastened to the upper ends of the splints, and the extending to the transverse bar passed through the mortises at the lower extremities, and the whole apparatus thus secured by strips of muslin tied around it. The long thigh splints of Desault may also be used for the same fracture, instead of the shorter splints of Hutchinson.

Mr. Fergusson describes an apparatus contrived by himself and Mr. Weiss, which is intended to obviate the above mentioned deformities resulting from muscular contraction. It consists of a straight bar of iron, extending from the knee beyond the sole of the foot, to which a foot-piece is attached in such a way as to be movable upwards towards the knee, and also laterally, so as to enable the surgeon to counteract any tendency to inversion or eversion of the foot; screws are so adjusted as to secure the different parts of the apparatus in any desired position. The lower extremity of the splint rests upon an upright arm, which reposes steadily upon the

bed (fig. 84). For a more detailed exposition of this apparatus, the reader is referred to Mr. Fergusson's book, p. 303.

Fig. 84.

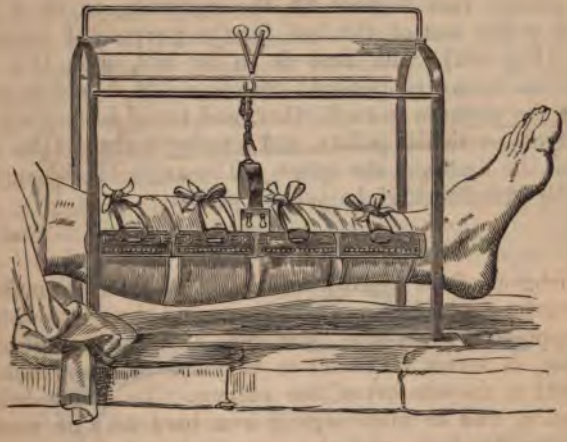


Whichever of the apparatuses described shall be employed, the surgeon may, if he so choose, suspend the part,—a practice supposed by many to be attended with advantages. At any rate, it serves very well to vary the position, and may thus add to the comfort of the patient. To accomplish the suspension, two or more strong iron bars may be made to arch over the limb, and the apparatus may be suspended from them. Or the more elegant arrangement of Mr. Salter, recommended and described by Mr. Fergusson, (p. 305,) may be used. It is "in most respects like a common metal cradle, but at the top will be seen a strong and smooth bar of iron, on which a couple of pulleys play; these glide readily along the bar, and there is a hook attached to them below, to which, by means of a chain, a case for holding the leg is attached. When the leg is placed in this case, it will, in slight movements of the body, swing from the hook by means of the chain; and in larger movements—as in using the bed-pan, or taking a new position in bed—the pulleys will roll to and fro, so that there is no probability of the fragments gliding upon each other, or the seat of fracture being in any way disturbed. The case below is so constructed that various parts of it can be unhooked, so as to permit of dressings being applied in instances of compound fracture." (Fig. 85.)

If the treatment by position is decided upon, the ordinary double inclined plane may be used, as advised in fractures of the thigh, a foot-board being attached to the lower plane, so that the foot may be well supported in the proper position.

Or the fracture-box just described may be placed upon a double inclined plane, and the leg properly arranged in it.

Fig. 85.



The last will probably be found to be the best plan, as the leg can thus be more securely disposed of, than when the plane alone is used; in the latter case, lateral splints should be employed to steady the leg, and to make the necessary compression upon the sides. By thus flexing the knee, the muscles which draw up the lower fragment of the tibia are rendered almost inoperative, and the apposition of the two portions of bone is secured very readily; a bandage of Scultetus may be advantageously employed for a few days, around the seat of fracture, but it should be removed daily, and the condition of the leg be inspected.

Mr. Liston has devised a double inclined plane for the treatment of fractures of the leg, which he thinks superior to any other; it is also well recommended by Fergusson and many other English surgeons. "It consists of a thigh and leg-piece of sheet-iron, and a foot-board of wood; the former are joined to each other by a couple of hooks and a screw, which is so placed that the two plates can be set to any angle at which it may be desirable to bend the knee, and the foot-board is so affixed that it may be slid upwards or downwards,

to suit the length of the limb, and fastened by a side screw in any position that may be advisable. At the lower end of the machine there is a cross-plate of iron, which is so attached that, in the event of the foot being raised or depressed, it will always rest flatwise on the mattrass, or on a board placed at the foot of the bed for the purpose of supporting it." (Fig. 86.) The limb is to be laid upon the splint, which has been well padded; cotton or tow should be used to adapt the surfaces to each other, and to aid in making pressure upon particular points, and a roller is then to be passed around the limb and the splint. The angle of the apparatus may be varied as may be judged proper.

Fig. 86.



2. If the tibia alone is broken, the displacement cannot be very great; the accident may be treated by any of the methods above spoken of, or a splint of pasteboard, previously moulded to the leg, may be applied upon the inner or inferior surface, and confined by a roller, or by the starched bandage, and the limb kept at rest upon a pillow. But even in simple fracture of the tibia, it is safer to make use of the fracture-box, at least during the first week or ten days: the same precautions and attentions should be used during the treatment, as in the cases above considered, though they are less necessary.

3. In fracture of the fibula only, when the injury has occurred above the lower three inches of the bone, nothing more than a simple lateral or angular displacement ensues, and the treatment demanded is the same as has been just advised for simple fracture of the tibia. But when the fracture has occurred at the lower two or three inches of the bone, constituting what is called "Pott's fracture," a great lateral displacement is produced, rendered more remarkable by rupture of the internal lateral ligament of the ankle, which in the ma-

jority of cases is caused simultaneously with the fracture of the fibula. The annexed drawing, taken from Mr. Lonsdale's book, p. 522, exhibits the point at which the bone is usually broken, the rupture of the internal ligament, and the peculiar deformity; (fig. 87,) and it shows the applicability of the mode of treatment recommended by Dupuytren. This method consists in the application to the tibial side of the leg of a splint and cushion of peculiar conformation. "The cushion, made of cloth and filled two-thirds with chaff, should be two feet and a half long, four or five inches wide, and three or four inches thick. The splint, from eighteen to twenty inches long, two and a half inches wide, and three or four lines thick, should be made of firm and slightly flexible wood. Lastly, the two bandages used should be each four or five yards in length, and two and a half inches wide. The cushion, folded upon itself in the form of a wedge, is applied to the inner side of the fractured limb, upon the tibia, its base directed downwards, being laid upon the internal malleolus, and not passing below it, its apex reposing upon the internal condyle of the femur. The splint laid upon this cushion should extend beyond it, from four to six inches, and beyond the inner edge of the foot three or four inches." One of the rollers is used to confine the upper part of the splint and cushion upon the leg, while the other draws the foot towards the inferior end of the splint, "being directed successively from the latter over the upper surface of the foot, upon its outer side, under the sole of the foot, upon the splint; then from this upon the instep and under the heel, to return again to the splint, and to be continued in the same manner until all the bandage is used. The foot is brought into such a state of adduction, that its external margin becomes inferior, the sole of the foot being directed inwards, and its internal edge upwards." (Dupuytren, Leçons Orales, tom. i. p. 226.) The annexed figure illustrates the application of this splint. (Fig. 88.)

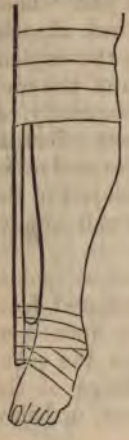
Fig. 87.



Most cases of this fracture may be treated with complete success by the fracture-box. A reference to fig. 87 will show

the points upon which compresses should be placed, to rectify the deformity; viz. one upon the external malleolus, and the other upon the side of the tibia, just above the extremity of the bone; then, when the sides of the box are brought up against the foot-board, the foot will be forced into its proper position, and thus retained. The advantages of Dupuytren's splint are, that the patient need not be confined to bed for any length of time, but may walk with his broken leg supported in a sling depending from the neck, or he may be allowed to travel, if his circumstances require it, provided care be taken to support the member.

Fig. 88.



The apparatus, whichever it be that is used in the treatment of fractures of the leg, may be suspended from the ceiling, or from the top of the bed, according to the plan recommended by Sauter and Mayor: this method has been already sufficiently explained, to enable the surgeon to adapt it to the fractures in question. It is difficult, however, to see the particular advantages which would result from such a modification of the stationary apparatus.

When fractures of the leg occur in persons who are at the same time affected with mania-à-potu, perhaps the most secure bandage will be the starch bandage with splints of pasteboard.

4. Compound fractures of the leg must be treated after the general principles recommended in similar injuries of the arm and thigh. The bran-dressing, first resorted to by Dr. J. R. Barton, of this city, and to which allusion has been before made in these pages, is particularly well adapted to the treatment of compound fractures of the leg. In such cases, the bran is used as a substitute for the pillow employed in simple fractures. The fracture-box has a sufficient quantity of the bran laid upon the bottom of it, to afford a soft resting-place for the leg; the leg is placed upon it, the form of the limb adjusted as well as possible, the foot is properly attached to the foot-board; then the sides of the box are closed, and the box itself filled with bran. The requisite degree of lateral pressure can generally be gained by packing the bran pretty firmly opposite particular parts of the leg; and in addition, a few

strips of adhesive plaster may be drawn around the limb at the point of fracture, without closing the wound entirely, or materially interfering with the ready exit of the pus. Thus the leg is imbedded in the midst of a substance which absorbs at once the discharged matters; which diminishes the unpleasant fœtor, by secluding the pus from the action of the air; which is itself clean, light, and cool, and which is easily renewed. It will be found, moreover, to be the most effectual mode of preventing the deposition of the ova of flies and other insects which, in our warm summers, become developed in the wound and are the source of great inconvenience and annoyance.

The disposition to the formation of abscesses at points remote from the wound is often met with in compound fractures of the leg. When formed, they should be opened as soon as possible, and the matter confined between the point of incision and the original wound by a few strips of the bandage of Scultetus laid above the seat of abscess, or below it, as the case may be.

Very generally in these injuries, the wound is on the anterior face of the leg; but it sometimes happens that the integuments are ruptured on the posterior face, or on one side; in the latter cases the fracture-box may still be employed, care being had that too great pressure is not exercised upon the wound itself. But when the solution of continuity exists on the posterior part of the leg, some apparatus must be resorted to which will allow the limb to repose upon its side. For this purpose, a wooden splint may be used, grooved to receive the leg, and terminating below in a foot-piece. The patient should repose upon his side, the thigh and leg flexed and resting upon pillows. The broken leg should be placed in the splint, (on the side opposite to the wound, so as to leave the latter exposed,) and confined to the splint at the knee and at the foot, by means of rollers. Little force will be required, generally, to retain the fragments in apposition, the flexed position in which the whole limb is placed itself relaxing the muscles: but compression may be resorted to, if necessary, by strips of adhesive plaster, or of the bandage of Scultetus, laid above and below the wound, while this is covered with a poultice, or some other suitable dressing; the pillows should be protected by a piece of oil-cloth, upon

which bran, cotton, or any absorbing material, should be placed, to catch the discharges from the wound.

SECTION IV.

FOR FRACTURES OF THE BONES OF THE FOOT.

Very little displacement accompanies simple fractures of the bones of the foot, as a general rule, and therefore the treatment is very simple. The foot should be kept at rest, with a splint of wood, or of pasteboard, bound to its sole, and a broad compress applied on the superior surface. Or an equally good plan consists in placing the leg in a fracture-box, with the sole of the foot confined to the foot-board, by a broad band, which leaves the dorsum of the foot sufficiently exposed to the action of local antiphlogistic applications.

When the posterior extremity of the os calcis is broken, there need not be much displacement, if, as is generally the case, the strong plantar ligaments connected with this part of the bone remain unruptured. Under other circumstances, however, the fragment is more or less drawn from its natural position, by the contraction of the gastrocnemius and soleus muscles, and the treatment employed must be adapted to counteract their influence. For this purpose the apparatus recommended by Mr. Lonsdale is very simple and effectual. It consists of a foot-piece of wood, to the extremity of which the end of a slipper is attached, for the reception of the toes. The foot-board should be rather shorter than the sole, so as to extend from the toes not quite to the heel; to its under surface a ring is attached. A pad, or compress, is placed upon the extremity of the os calcis, (the fragment having been restored to its proper position), and confined thus by a few turns of a roller; then a strap of leather, or a band of webbing, is passed through the ring of the foot-board, upwards over the heel and the pad, over the calf of the leg to the lower third of the thigh, where it is reflected upon itself, — the knee being flexed, and the foot extended, — and confined to the surface by turns of a roller, (fig. 89.)

This same apparatus will answer for the treatment of rupture of the tendo Achillis, with the addition of a roller

Fig. 89.

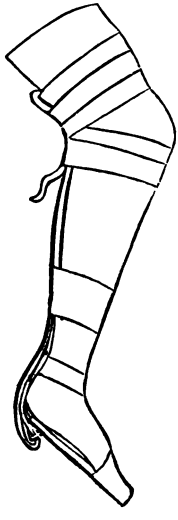


Fig. 90.



applied carefully from the toes to the knee. The same effect may be gained by a method even more simple than this, as follows: Encircle the lower part of the thigh with a strap, or a roller tightly applied, and connect this, by means of a strip of muslin, to the heel of a slipper placed upon the foot, —the leg being flexed upon the thigh; envelope the foot and leg in a roller. The annexed drawing, from Druitt, exhibits this plan of treatment, (fig. 90.)

In compound fractures of the bones, the foot should be kept in the same position as in case of simple fracture, with a poultice, or other proper dressing applied over the part.

PART IV.

ON THE MECHANICAL MEANS EMPLOYED IN THE TREATMENT OF DISLOCATIONS.

A DISLOCATION, or luxation, is defined by Sir Astley Cooper to be, "a displacement of the articulating portion of a bone from the surface on which it was naturally received." This faulty position is maintained, and the reduction of the dislocation opposed, by a combination of causes; sometimes, and partially, by the conformation of the bony surface on which the displaced member rests, as the prominent margin of the acetabulum, in dislocations of the hip;—occasionally, to a certain extent, by the situation and condition of the ligaments about the joint;—but chiefly and in every case, by the powerful clonic and tonic action of the muscles. These obstacles cannot be overcome without resort, on the part of the surgeon, to physical force.

It does not fall within the province of this volume to discuss the pathology of this class of accidents; its limits and its legitimate intention permit only a description of the mechanical means employed in their treatment. The subject naturally divides itself into two branches: 1st, the means of reducing the dislocation, or of restoring the displaced bone to its natural situation; 2d, the mode of retaining the bone in place, until the necessary reparation of the injury done to the tissues shall have become perfected.

Luxations are replaced by means of muscular force acting directly upon the two bones involved, or indirectly through the intervention of some mechanical apparatus, the object of which is to increase the power of the muscles, and to render it more uniform and more equable in its operation. The force thus excited must act in two opposite directions: one, — the extending,—upon the movable part, that which has been displaced; while the counter-extension is exercised on the opposite part, serving merely to fix and steady it. The points

upon which these forces operate vary in different dislocations: generally, the muscles which directly surround the joint, and which, if they are excited to contraction by any cause, may interfere with the execution of the object in view, should not be compressed by the extending and counter-extending powers, unless from motives of convenience and expediency.

To assist the action of the mechanical means, in all instances where the resistance of the muscles is great, or where much pain is likely to be experienced for any length of time, it is important to depress the irritability and power of the muscles, and the nervous sensibility, by anæsthetics, or some other agent.

When the dislocation has been reduced, there is, generally, but little disposition to re-displacement: it is necessary merely to keep the muscles surrounding the joint, and the joint itself, in a state of repose, for a certain time. This object is secured by the application of retentive bandages and splints.

The special dislocations will be briefly considered, with particular reference to the mode in which the various mechanical means alluded to are applied.

CHAPTER I.

DISLOCATIONS OF THE BONES OF THE HEAD AND TRUNK.

SECTION I.

DISLOCATION OF THE LOWER JAW.

REDUCTION.—In this accident the articular surface of one, or of both, of the condyloid processes of the inferior maxilla rests upon the base of the zygomatic process, being thrown forwards out of the glenoid cavity, as is represented in the annexed wood cut, (fig. 91.) To remedy the deformity, the surgeon places his thumbs, well wrapped around with muslin, to protect them from injury, between the posterior molar teeth on each side of the jaw, grasping the base of the bone on each side with his fingers; then, the patient's head being well supported against the back of a chair, or by the hands of an assistant, the surgeon presses his thumbs strongly downwards upon the molar teeth, while with his fingers he forces the chin upwards; thus the condyloid processes are removed from their false position, and by the contraction of the muscles connected with the posterior part of the bone, are drawn into the glenoid cavities.

FIG. 91.



The succeeding treatment consists in the application of a simple retentive bandage, as that of Barton, or of Gibson,

(see Fractures of Lower Jaw,) and in nourishing the patient for the following two or three weeks with liquid food.

SECTION II.

DISLOCATIONS OF THE BONES OF THE TRUNK.

If the vertebræ, the ribs, or the bones of the pelvis chance to be separated from their articular connexions, the accident is generally accompanied by other serious, if not fatal, injuries to the organs contained in the thoracic, abdominal and pelvic cavities. The surgeon can do little or nothing towards replacing the dislocated bones. Perfect rest should be enjoined, with the use of such local and general antiphlogistic remedies as may be requisite. The simple body-bandage for the chest, or pelvis, will effect all that can be expected of any mechanical contrivance; or the bandages shown in figures 29, 31 and 76 may be employed, according to the region injured.

SECTION III.

DISLOCATIONS OF THE CLAVICLE.

Either articular extremity of the clavicle may be luxated: the modes of effecting reduction are very similar in all varieties of the accident. The patient being seated, the surgeon takes a position behind him, grasping each shoulder, and having one knee placed against the spine between the shoulders, so as to steady the patient, while he draws the shoulders backwards, and thus operates upon the clavicle. The natural distance between the shoulders having been regained, pressure must be made upon the extremity of the reduced bone with the hand, until a suitable bandage can be applied.

AFTER-TREATMENT. — The retentive means employed to maintain the reduction should accomplish two indications; viz., to prevent the shoulder from falling downwards, forwards, and inwards, and to exert a certain degree of pressure

upon the dislocated extremity of the clavicle. If the humeral end of the bone has been luxated, both of these indications will be fulfilled by the application of the figure-8 bandage of both shoulders, a pad being placed in the axilla of the affected side and a compress upon the end of the bone (fig. 92), while the fore-arm is supported in a sling upon the front of the chest. If the accident has occurred to the sternal extremity of the clavicle, the same bandage should be employed, with the addition of a compress upon the injured articulation, to be retained in this situation by means of a few turns of a roller made to encircle obliquely the upper part of the chest, passing across the root of the neck of the injured side, over the sternal extremity of the clavicle, under the axilla of the sound side, and so around the back to the starting-point. Dr. W. Poyntell Johnston, some years ago lecturer on Surgery in this city, was in the habit of recommending the use of the common hernia-truss in the treatment of this accident, the pad being made to press upon that extremity of the clavicle which had been dislocated; the truss can be easily secured in position by a few turns of a roller, or by a handkerchief.

Fig. 92.



CHAPTER II.

DISLOCATIONS OF THE BONES OF THE UPPER EXTREMITY.

SECTION I.

DISLOCATIONS OF THE HUMERUS.

THE head of the humerus is liable to three principal varieties of displacement, viz., 1st, in the direction downwards into the axilla; 2d, forwards, under the pectoralis major muscle; 3d, on the dorsum of the scapula.

In all of these, the principle of reduction is the same, varying only in the line in which the reducing force is made to operate. There are, however, several methods by which the restoration may be accomplished.

1. By the heel in the axilla. The patient should assume the recumbent position on a bed, or on the floor; the surgeon sits by his side, and places one heel in the axilla, in contact with the head of the humerus, thus fixing the body; the extending force is applied either to the arm above the elbow, or to the wrist. By the former plan, the surgeon flexes the patient's fore-arm so as to relax the biceps muscle, and secures a double roller-towel upon the arm above the elbow, by means of a wetted bandage; he then passes the towel over his own neck, and under the axilla of the side next the patient. (Fig. 93.) It may be objected to this method, that the triceps and biceps muscles may be stimulated to contraction by the pressure exercised upon them, and thus oppose the reduction. By the other mode, the surgeon grasps the patient's wrist either with the hand, or through the medium of a bandage, or of a double towel arranged in the manner above described. The last method is probably the best, as it does not directly affect the muscles which pass from the scapula to the lower part of the humerus and the fore-arm. By employing the double towel, in either mode of operating, the surgeon may avail himself of the power of the muscles of the back

as well as of those of the arms. The extension should be made gradually and steadily in the direction assumed by the

Fig. 93.



humerus, and the head of the bone may be acted upon by the heel of the surgeon also, so as to be dislodged from its position in the axilla.

2. By relaxing the supra-spinatus muscle and the deltoid, which, according to Sir A. Cooper (op. cit. pp. 321, 2), are

Fig. 94.



the chief opponents of the reduction. The patient lies down, as in the first method; the surgeon sits behind him, and

extends the dislocated arm with one hand, while with the other he fixes the scapula. (Fig. 94.) If this simple manual force is not sufficient, the scapula may be secured by means of a double towel passed around it, crossing the axilla, and confined to the bedstead, or to the floor, on the opposite side of the patient; while pulleys are employed to make the necessary extension, as will be explained directly; or, again, extension may be effected by means of the double towel passed around the surgeon's back and shoulder, as already described.

3. By the pulleys. It is necessary, in the employment of the pulleys, to fix the scapula by some mechanical means. This may be best accomplished by a broad piece of canvass, or leather, in which a hole is made large enough to admit the shoulder; this band should pass in front of and behind the chest, and be secured to a hook in the wall, or the floor, if the patient is in the recumbent position. The annexed drawings from Fergusson, illustrate the kind of pulleys which are used,

Fig. 95.



and the ring to which one of their hooks is attached during the extension. (Fig. 95.) The other hook should be fastened to a towel, which has been secured upon the arm above the elbow, by means of a wetted roller. The cord of the pulleys should be drawn, by an assistant, slowly and steadily, and be relaxed as soon as the surgeon, who has his hands upon the head of the bone and the shoulder, feels that the former has been drawn out from beneath the glenoid cavity.

It may be of service sometimes, that the surgeon should place his knee beneath the humerus near to its head, in order to gain a fulcrum upon which, by depressing the elbow, the head of the bone may be elevated towards the glenoid cavity. (Fig. 96.)

Fig. 96.



The use of the pulleys is necessary in cases where, from long-standing dislocations, or from the great muscular powers of the individual, a very considerable, and a very steady and long-sustained force is required to reduce the head of the bone. In such instances, resort should be had to general depressing means, as bleeding, the administration of nauseating doses of tartar emetic, &c.

Any of the varieties of dislocation of the humerus may be reduced by these means, but the direction in which the extending force should act, must be modified with each luxation. In the dislocation downwards, the arm should be drawn downwards and a little outwards from the side, to correspond with the direction of the axis of the humerus. In the luxation forwards, the arm points outwards and backwards, and the reducing force should operate in the same direction. When

the head of the bone is thrown upon the dorsum of the scapula, the extension must be made forwards and outwards.

A complicated and expensive, though ingenious apparatus, known in this country and in Europe as "*Jarvis's Adjustor*," was invented some years ago by Dr. G. O. Jarvis, of Connecticut. It consists of several pieces of iron, shaped to correspond with the form of the different parts of the upper and lower extremities; these are to be secured upon the dislocated member by means of straps and buckles. The extending power, which accomplishes the reduction, is applied by means of a rack-and-pinion-wheel. It is applicable both to dislocations and to fractures. Those who are desirous of seeing representations of the apparatus, and the manner in which it is to be employed, we would refer to a series of lectures upon the subject by its inventor, published in the London Lancet, for 1846, Vol. I.

The apparatus is a very powerful one, unquestionably, and, we dare say, can be made to accomplish what its maker promises. But we believe, that with the ordinary pulleys, aided by anæsthetic influence, the surgeon can exert as much force as is necessary or safe, and can direct it perhaps better than by the "*Adjustor*." Moreover, (and this we think a very important consideration!) the surgeon knows how much force he employs, if he uses the pulleys; whereas, if he brings the apparatus in question to bear upon a dislocation or fracture, he cannot judge of this so accurately, and he is consequently much more likely to do mischief in his efforts to benefit his patient. These considerations, together with the costliness and complicated character of the machine, and the fact that we can succeed very well with the means which have been so long in use, render it hardly worth while to burthen ourselves with "*Jarvis's Adjustor*."

AFTER-TREATMENT.—The fore-arm should be supported in a sling, in the semi-flexed position, on the chest, a pad should be secured in the axilla, and the arm bound, with a moderate degree of pressure, to the side. Local antiphlogistic applications, as lead-water, cold poultices, or leeches, may be made as required. The apparatus should be continued for ten days or two weeks.

SECTION II.

DISLOCATIONS AT THE ELBOW-JOINT.

Of these there are six varieties: 1st, in which both bones are thrown backwards, the olecranon process projecting very much posteriorly; 2d, in which both bones are drawn backwards and inwards; 3d, when both are thrown backwards and outwards; 4th, the ulna alone is forced backwards, the orbicular ligament of the radius being ruptured, but this bone itself remaining on the anterior face of the external condyle; 5th, the radius forced forwards into the depression above the external condyle, the ulna remaining in situ; 6th, the radius thrown backwards behind the external condyle of the humerus. In all the varieties the reduction is generally easily effected. In the first four species, the restoration may be accomplished by placing the knee at the bend of the elbow, and flexing the fore-arm upon it, the lower part of the upper arm and the fore-arm being grasped by the hands of the surgeon. The dislocations of the radius may be remedied by fixing the humerus and making extension from the hand, while the bone is thrown forwards; if the luxation be backwards, the same extension and counter-extension should be made, while at the same time the fore-arm should be flexed, thus forcing the biceps to draw the radius to its proper place.

Subsequent Treatment.—The fore-arm should be placed in the semi-flexed position, and an angular splint should be bandaged upon the front of the whole limb, compresses being placed upon the head of the bones opposite the direction of the luxation. This confinement must be maintained for two or three weeks, passive motion being carefully instituted after the first few days.

SECTION III.

DISLOCATIONS OF THE LOWER EXTREMITY OF THE FORE-ARM.

These accidents are usually caused by falls upon the hand. Both the radius and ulna may be thrown either backwards or forwards upon the wrist, causing considerable projection in these situations, or one of the bones only of the fore-arm may be separated from its connexions and displaced anteriorly, posteriorly, or laterally. The reduction is easily accomplished by simply extending and counter-extending from the hand and the fore-arm, and making moderate lateral pressure at the same time, if the displacement be at the side of the wrist.

SUBSEQUENT TREATMENT.—Place a straight splint on the front, and another on the back of the fore-arm and hand, with compresses on the anterior and posterior surfaces of the wrist, and secure the whole by a roller. The fore-arm should be supported in a sling.

SECTION IV.

DISLOCATIONS OF THE BONES OF THE HAND.

Instances have been met with, in which some one or more of the carpal bones have been thrown from their natural positions, so as to form projections upon the back of the hand, without a wound of the integuments. They may generally be replaced by pressure: the reduction should be maintained, by placing compresses upon the palmar and dorsal aspects of the wrist, and upon these straight splints, the whole to be enveloped in the folds of a roller. The hand should be supported in a sling.

The same treatment, conjoined with some degree of extension in the reduction, is applicable to dislocations of the metacarpal bones, should they occur without laceration of the integuments.

Dislocations of the phalanges may ordinarily be reduced without much difficulty, if the accident is attended to soon after its occurrence. Sometimes restoration may be accomplished by simply bending the displaced phalanx over the head of the bone from which it has been dislocated, as represented in the annexed drawing. (Fig. 97.) Frequently, however, con-

Fig. 97.



siderable extension and counter-extension are requisite. To effect this, a piece of cord should be wound around the phalanx, the skin being protected by a covering of wetted buckskin; then, the hand being fixed, the surgeon should extend the finger, at first in the axis of the bone, and gradually flex it towards the palm, in order to relax the flexor muscles, if the dislocation be posteriorly; or, if the phalanx has been thrown upon the palmar face of the other bone, it should be forced a little backwards, during the extension. (Fig. 98.)

Fig. 98.



The most convenient mode of securing the extending cord or tape, is by making what is termed the "clove-hitch," as shown in the accompanying drawing, (fig. 99,) from Fergusson.

Dislocation of the phalanges of the thumb is most difficult of reduction. The following is the method recommended by Sir A. Cooper, p. 446: "The extension is to be made by bending the thumb towards the palm of the hand, to relax the flexor muscles as much as possible, and the following is the mode of applying the extending force: The hand is to be first steeped in warm water for a considerable time, to relax the parts as much as possible; then a piece of thin wetted leather is to be put around the phalanx, and as closely adapted to the thumb as possible: a piece of tape about two yards in length is next to be applied upon the surface of the leather, in the knot called the "clove-hitch," for this becomes tighter as the extension proceeds. An assistant places his middle and forefinger between the thumb and forefinger of the patient, and makes the counter-extension, whilst the surgeon, assisted by others, draws the phalanx from the metacarpal bone, directing it a little inward towards the palm of the hand." (Fig. 100.)

Fig. 99.



Fig. 100.



The quiescence of the joint after dislocation of the metacarpal, or phalangeal bones, is to be maintained by splints and compresses placed upon the dorsal and palmar aspects of the hand.

CHAPTER III.

DISLOCATIONS OF THE BONES OF THE LOWER EXTREMITY.

SECTION I.

DISLOCATIONS OF THE HIP-JOINT.

Of these there are four chief varieties, named from the false position which the head of the os femoris assumes; they are as follows: — 1st, upwards, or on the dorsum ilii; 2d, downwards, or into the foramen ovale; 3d, backwards and upwards, or into the ischiatic notch; 4th, forwards and upwards, or on the body of the pubis.

These require, on the part of the surgeon, the employment of a greater degree of force in reduction than dislocations of any other bone, owing to the much greater power of the muscles concerned. In young children they may generally be restored by simple manual extension and counter-extension, as the luxations of the humerus; but in adults, the pulleys should always be employed, and it is almost always advisable to have recourse also to depressing agencies, as bleeding to the amount of from twelve to twenty ounces, or the hot-bath at 100°, or the administration of tartar emetic in doses of half a grain every ten minutes, until nausea is produced, or, still better, probably, by bringing the patient under the anæsthetic influence of ether or chloroform.

As in other dislocations, the reducing forces should act gradually and steadily, and in the line of the axis of the dislocated bone, and during their operation, the patient's mind should be interested, if possible, in some subject other than his accident.

The treatment of the individual dislocations is as follows:—

1st. The dislocation upwards on the dorsum ilii. The patient is placed upon a table covered with a mattrass, or

folded blankets. The pelvis is fixed by means of a sheet folded longitudinally, passed under the perineum and over the crista of the ilium, and secured to a staple so situated that the sheet may be in a line with the axis of the thigh. The extension is effected through the intervention of a wetted roller secured upon the lower part of the thigh, and having buckled around it a leathern band with a short strap on each side terminating in a ring; the two rings are to be attached to the hook of the pulleys, and the latter secured to a staple in such a position that the extending and counter-extending forces may act parallelly to each other, from opposite points, and to the axis of the bone. Instead of the leathern band, a double towel may be confined to the thigh by the clove-hitch. The knee of the dislocated limb should be bent nearly at right angle and pointed across the thigh a little above the knee of the other leg. After the muscles have been fatigued by the continued action of the pulleys, the surgeon should grasp the knee, and rotate the hip slightly and gently, or he may pass a towel around the upper part of the thigh, and raise thereby the head of the bone, when it will usually slip into the acetabulum, (fig. 101).

Fig. 101.



The subsequent treatment consists in keeping the patient in bed for two weeks or more, his knees tied to each other by a strip of muslin, and a broad belt passed around his pelvis pressing upon the trochanters.

2d. The dislocation downwards, or into the foramen ovale. To reduce this luxation, the following course should be pursued: The patient should be in the recumbent position, as in

the first case; a girth made of leather, or of a sheet, or towel, should be passed around the upper part of the thigh and attached to one of the hooks of the pulleys, the other being secured to a staple fixed in the wall opposite the dislocated hip; another girth should be made to encircle the pelvis, so as to steady the body, passing the noose formed by the first girth, and attached to a staple placed opposite to the first, on the sound side of the patient. The cord of the pulleys should now be drawn until the head of the femur begins to leave its position in the foramen ovale, when the surgeon should pass his hand behind the ankle of the sound limb, and grasp the other ankle, which he draws steadily towards him; the effect of this is, to throw the head of the bone outwards, the limb being a lever with its fulcrum on the extending girth; as soon as the head of the femur is sufficiently disengaged from its false position, the extending force should be suspended, when the limb will be restored, (fig. 102.)

Fig. 102.

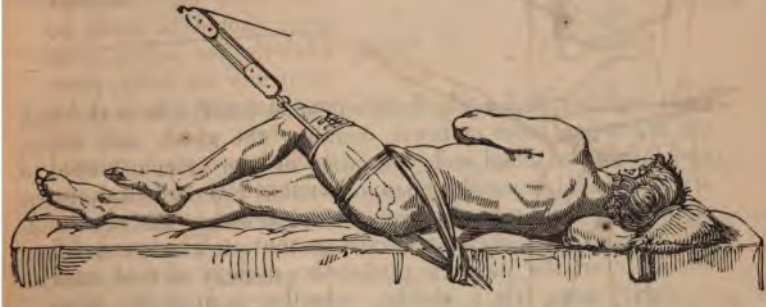


The after-treatment is as in the first case.

3d. To reduce the dislocation backwards, or into the ischiatic notch:—Secure the extending and counter-extending bands as in the first species of luxation; then, the patient reposing upon his sound side, the knee of the dislocated limb should be pointed across the middle of the opposite thigh, and the extension practised until the muscles are enfeebled;

a round towel should now be passed under the upper part of the thigh, and over the shoulders of an assistant, who should be directed to press upon the pelvis with his hands, and at the same time to raise his shoulders: thus the head of the femur will be extricated from the ischiatic notch, and drawn downwards into the acetabulum. (Fig. 103.)

Fig. 103.



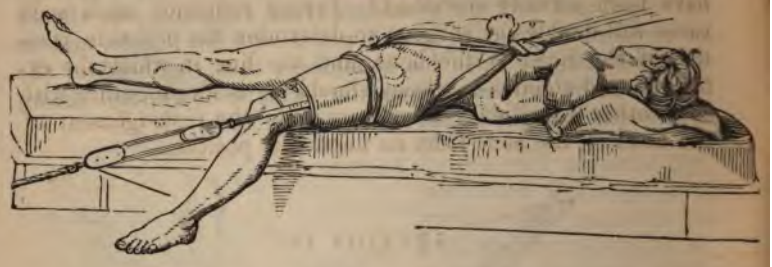
The subsequent treatment does not differ from that advised for the other cases.

4th. To restore the luxation forwards and upwards, or on the pubis:—The apparatus employed is the same as has been already described, and its mode of application is as in the last-named variety of the accident. The patient should be placed upon his sound side, the knees widely separated from each other, and the extension made in a line behind the axis of the body. When the muscles have been sufficiently fatigued, a round towel should be passed under the upper part of the thigh, and around the shoulders of an assistant, who elevates the head of the femur by raising his shoulders, pressing at the same time upon the pelvis. (Fig. 104.)

After-treatment.—The same as in the other varieties.

A very good and simple substitute for the pulleys has been recently recommended by Dr. Gilbert, Professor of Surgery in the Pennsylvania Medical College. Its mode of application is thus described in the American Journal of Medical Sciences, vol. ix., N. S.:—"Place the patient and adjust the extending and counter-extending bands as for the pulleys; then procure an ordinary bed-cord, or a wash-line; tie the

Fig. 104.



ends together, and again double it upon itself, pass it through the extending tapes or towel, doubling the whole once more, and fasten the distal end, consisting of four loops of rope, to a window-sill, door-sill, or staple, so that the cords are drawn moderately tight; finally, pass a stick through the centre of the doubled rope, then by revolving the stick as an axis, or double lever, the power is produced precisely as it should be in such cases, viz.: slowly, steadily, and continuously." (Fig. 105.)

Fig. 105.



Several instances of anomalous dislocations of the head of the femur are recorded by Cooper and others. (Sir A. Cooper, op. cit., pp. 83–97.) The means employed in the

treatment of these are the same as in those varieties which have been already described. Proper reflection upon such cases will enable the surgeon to determine the probable position of the head of the bone, and the line in which the extension and counter-extension should be made, together with such other expedients as will assist in the dislodgement of the head of the bone from its unnatural position.

SECTION II.

DISLOCATIONS OF THE PATELLA.

The patella is liable to displacement in two directions, without rupture of its tendon or ligament, viz.:

1st. Dislocation outwards, the bone resting upon the external condyle of the os femoris, causing great projection at this point, and an inability to flex the knee.

2d. Dislocation inwards, producing the same difficulty in bending the knee, with a marked prominence at the inner condyle of the femur.

The restoration is generally easily accomplished, by relaxing the extensor muscles of the leg: for this purpose the heel should be elevated upon the shoulder of an assistant, while the surgeon presses down the edge of the patella which is most removed from the centre of the knee-joint, thus tilting up the other edge of the bone, when the muscles, aided by a lateral pressure, will draw the patella to its place.

The subsequent treatment consists in confining a straight splint to the posterior surface of the limb, and in making moderate pressure upon the knee by means of a roller, or a laced bandage; local antiphlogistic applications are generally required, in addition. The patient should be confined to bed for about two weeks.

SECTION III.

DISLOCATIONS OF THE TIBIA AT THE KNEE.

Of these there are four varieties, viz.:

1st. Displacement forwards,—the tibia being thrown upon the anterior part of the thigh, of which the condyles are depressed backwards, and somewhat to the side. (Cooper.)

2d. Backwards,—the tibia drawn upwards behind the condyles of the femur, which project very much on the front of the leg.

3d. Inwards,—the internal condyle of the thigh-bone resting upon the external semilunar cartilage.

4th. Outwards,—the inner semilunar cartilage being in contact with the external condyle of the femur: the great lateral projection of the head of the tibia in these cases renders the diagnosis of the injury very easy.

These dislocations are readily reduced by making extension and counter-extension from the ankle and thigh, conjoined with moderate pressure upon the head of the tibia. After the restoration is accomplished, the limb should be secured to a straight splint, and such local antiphlogistic means should be employed as the circumstances of each case may call for. The patient should be kept in bed for ten days or two weeks, or longer, if there be continuance of pain or of inflammation.

SECTION IV.

DISLOCATIONS OF THE HEAD OF THE FIBULA.

The head of the fibula is sometimes detached from its connexions with the tibia, and drawn backwards by the action of the biceps. It is easily restored to its place, by flexing the leg so as to relax this muscle, and pressing the bone forwards.

In order to retain it "in situ," the leg should be kept bent over a pillow, or an inclined plane, with a compress bound

against the posterior part of the head of the bone by means of a roller.

SECTION V.

DISLOCATIONS OF THE ANKLE.

The astragalus may be separated from the bones of the leg in four directions, viz.: forwards, backwards, outwards, and inwards. The recognition of the accident is easy, and the reduction not difficult. The limb should be flexed, so as to relax the powerful muscles on the back of the leg; then, while extension and counter-extension are made from the foot and the lower part of the thigh, the surgeon should press firmly upon the dislocated bone, and thus force it to its place.

After reduction, the leg and foot should be confined in carved splints, or splints made of binders' board, soaked in hot water and moulded to the shape of the limb, with a foot-piece at right angles; or a fracture-box will be found to answer equally well. This confinement to bed and in splints should continue for five or six weeks, and when the patient is first allowed to walk, the ankle should be carefully supported by a roller bandage, or a firm laced gaiter. The time requisite to perfect the cure of these accidents is, according to Sir A. Cooper, ten or twelve weeks.

If the fibula alone is separated from the tibia, simple lateral pressure will restore it to its place, after which a roller and compress should be employed for some weeks to retain the bones in apposition; rest is necessary, as in the last-described injury.

The remarks made on the treatment of dislocations of the bones of the hand and wrist are applicable to the same kinds of injury of the foot; the treatment to be pursued in the reduction, and subsequently, is similar, excepting that a greater degree of force is required to reduce the luxation, and a longer confinement afterwards, when the foot is involved than when the hand is injured.

CHAPTER IV.

COMPOUND DISLOCATIONS.

THESE accidents require the same sort of treatment as compound fractures. Much experience, and careful examination of all the circumstances connected with each case, are necessary to enable the surgeon to determine when to attempt to save a limb so injured, and when to amputate. This volume does not pretend to lay down rules for such cases. The reader will do well to consult the works of the Coopers, Vidal (de Cassis), Boyer, Chelius, and others, with reference to this important subject.

If an attempt to save the limb be decided on, the wound should be carefully cleansed, all foreign bodies, spicula, or small and detached fragments of bone, removed, hemorrhage arrested, and the dislocated bone restored, if possible. Then the edges of the wound should be apposed to each other, and covered, as in the case of compound fractures of the patella, &c., with a piece of lint dipped in blood, or in some agglutinative fluid, and every effort should be made to convert the injury into a simple dislocation. The tendency to re-displacement should be overcome by placing the limb in such a position as shall relax the most powerful muscles connected with the dislocated bone, and by the application of a bandage to make moderate compression upon the seat of injury and on the implicated muscles. The disposition to inflammation, or this condition itself, should be combated by leeches, occasionally by general bleeding, by irrigation with cold water, by evaporating lotions, and by position. Warm applications should be avoided, so long as there is any prospect of closing the wound by direct union. Perfect rest should be maintained in bed, if one of the lower extremities be involved, and such splints and other retentive and supporting appliances should be employed as will most conduce to the objects in view.

APPARATUS FOR THE RELIEF OF PARTIAL ANCHYLOSIS.

It not unfrequently happens after fractures involving a joint, dislocations, and other injuries or diseases, that the motion of the joint is very much impaired, and the usefulness of the whole limb much diminished. The difficulty may often be entirely relieved or lessened, by adapting to the limb some instrument, whereby constant and gradually increasing motion may be given to the joint for a length of time. The accompanying drawing (fig. 106) exhibits an apparatus of this kind for the arm, which is recommended by Professor Mütter, in his edition of Mr. Liston's "Lectures on the Operations of Surgery," &c., (p. 433, Am. edit., 1846.)

FIG. 106.



It consists of steel splints curved to the shape of the arm and fore-arm, and well padded, two for the upper arm and two for the fore-arm, for the anterior and posterior surfaces of the limb. The anterior splints are connected by a steel or iron bar, which is firmly secured to them on each side, and jointed by a pivot at the centre, so as to move freely like a hinge. A "Stromeyer's screw" is fastened to the centre of the same splints in front, by moving which the apparatus may be made straight or angular, at pleasure. The splints are now applied to the limb, those for each division of the member being secured to each other by means of straps and buckles, and thus made to surround the arm above and below its bend, care being had that the joint of the side bars is opposite the centre of motion of the elbow. When the apparatus is thus properly applied, the screw should be turned until the patient commences to experience slight uneasiness in the joint; this process should be repeated daily, now extending and now flexing

the limb,—avoiding the infliction of pain in the joint,—until an adequate degree of motion is restored: the action of the apparatus will be very much aided by frequently soaking the joint in warm water.

When so elegant a splint as that employed by Dr. Mütter cannot be obtained, the same effect may be had by attaching the screw to simple splints of wood. The apparatus may be adapted to the knee as well as to the elbow, and with equally good results.

PART V.

ON SOME OF THE MINOR SURGICAL OPERATIONS.

CHAPTER I.

ON INCISIONS.

We cannot attach much importance to, or advise any one to comply with, set rules for the mode of holding and using cutting instruments. We believe that each can judge best for himself in such matters; and that the most rational proposition is that each one shall use his knife in such a manner as will enable himself to gain, most readily and satisfactorily, the object which he has in view. Nevertheless, a few observations, offered as suggestions, may not be amiss touching the simple incisions of Minor Surgery.

In the first place, the cutting edge of the instrument to be used should be sharp. And it is important that the surgeon, especially if he reside in the country, remote from his cutler, shall be able to keep his knives in good order. For this end he must have a proper *hone;* one of the "*Water of Ayr*" stones of Scotland, or an Arkansas or Missouri stone, will answer the purpose. In making use of it, its surface should be moistened with olive oil, and the knife passed lightly over it from heel to point, the back being slightly raised from the stone, and equally, of course, on both sides of the blade. After the instrument has been honed until its cutting edge is smooth and sharp, it may be strapped, or not, as seems requisite; but if the hone be sufficiently fine, strapping will not be necessary.

Fancy has been very busy in contriving a variety of *shapes* for the simple *scalpel;* the one which we have before spoken of, (fig. 2,) will be found as advantageous as any. It is usually held between the thumb and the first two, sometimes the first three, fingers of the right hand. If the incisions are to be small in extent, and require to be delicately and carefully made, the knife may be held as indicated in fig. 107, the hand being steadied, if necessary, by the little finger or

Fig. 107.



wrist resting upon the part to be operated upon. If rapid and extensive incisions are to be made, and if the operator be practised, the instrument may be best held as shown in fig. 108; but the position must be varied according to cir-

Fig. 108.



cumstances. For example, if the surgeon be about to sever rugged and partially detached portions of a flap, or to pare the edges of a lacerated wound, he will find it most convenient, probably, to use the knife as illustrated in the accompanying drawing (fig. 109); if he wishes to open an abscess,

Fig. 109.



he may employ "Syme's abscess lancet," a curved blade, with a sharp point and a double cutting edge, as delineated in fig. 111, or he may plunge a common sharp-pointed bistoury through the integuments, as in fig. 110.

Fig. 110.



Fig. 111.



The direction of the incision to be made should depend upon the object to be gained. If it be desired merely to divide the parts, the cut is usually made in a *straight line*, the knife being entered perpendicularly to the surface, the wrist then depressed, and the edge of the instrument drawn along in contact with the skin; when the requisite extent of division has been gained, the wrist should be elevated, and the knife withdrawn perpendicular to the skin. Or if the parts be loose enough, the integuments may be pinched up between the thumb and fore-finger, and a sharp-pointed, narrow-bladed bistoury, straight or curved, may be thrust through the base of the fold, and made to cut its way upwards at the same time.

A *semilunar* incision is sometimes performed by sweeping the edge of the knife through the skin in a semicircular direction.

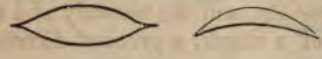
Fig. 112.



Sometimes it is advisable to make a *crucial* division of the soft parts, two straight incisions crossing each other at right angles. (Fig. 112.)

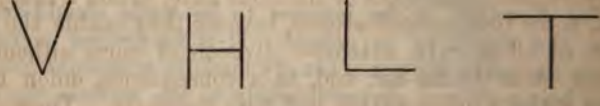
If it be desired to remove a portion of the integuments, as in the extirpation of a considerable tumour, where otherwise there would be a redundancy of covering, an *elliptical* incision is made, by uniting two semilunar cuts at their extremities. (Fig. 113.) Judgment must be used in performing this division; the contractility of the parts is such that, under ordinary circumstances, the resulting wound will gape much more widely than the amount of tissue abstracted will account for. It is better, therefore, to take away too little than too much; in the former event, time will diminish the difficulty, and pressure carefully employed will generally obviate any unpleasant effect; in the latter case, the edges of the wound cannot be brought together, excepting by so much straining as will be painful, and endanger inflammation.

Fig. 113.



Other incisions are represented in figs. 114, 115, 116, and 117; names are applied to them corresponding to the letters

Fig. 114. Fig. 115. Fig. 116. Fig. 117.



which in shape they resemble. They are designed to facilitate the exposure of the parts beneath the surface, the flaps of the integument being elevated for the time, and then replaced, and their margins made to unite.

The direction of the incision should depend somewhat, too, upon the situation of the part. Thus, on the face or neck, especially of a female, it is desirable that no unsightly scar should remain; this end may be gained, to a certain extent,

by dividing the skin in a line parallel to the direction of the fibres of the subjacent muscle. If it be advisable that the margins of the wound shall close readily, the skin must be divided in the manner just indicated: if it be preferred that the wound shall remain open, the incision should be more or less directly transverse to the course of the muscular fibres.

It is often necessary to prolong an incision of the integuments beyond the point at which the eye can direct the instrument. In such cases it is important to have a guide upon which the knife may be glided. For this purpose, the finger answers very well sometimes, as when the side of a hernial stricture is to be divided, the fore-finger of the left hand may be passed as high up as possible, and the bistoury slid in upon it (fig. 118,); or, instead of a finger, a *grooved director*

Fig. 118.



may be first introduced, and the bistoury then pushed along its furrow, as is usually done when successive layers of tissue are to be divided.

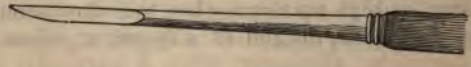
Subcutaneous wounds or incisions have, within a few years past, come into merited esteem, because they enable the surgeon to effect even extensive division of parts without exposing them to the air, and, as a consequence, union takes place without inflammation and very promptly. These incisions may be accomplished thus: if the object be to divide a tendon, or to open a joint, a fine, sharp-pointed knife, such as is represented in fig. 119, must be introduced through the in-

Fig. 119.



tegument, obliquely, at a little distance from the deeper point to be divided, and pushed on to the latter; now the point of the knife should be depressed and its edge a little turned towards the surface to be cut, and the division of this effected as by stealth, to use the expression of Mr. Miller. The instrument must be carefully withdrawn as it was entered, and the external orifice immediately closed by adhesive plaster, or covered with a piece of lint soaked in collodion, and perfect quietude of the part enjoined. A narrow-bladed knife, like that shown in the accompanying drawing, (fig. 120, taken

Fig. 120.



from Mr. Erichsen's book,) having only a part of the blade sharp, the remainder rounded, will answer very well for such sections.

Another method of making incisions of deep-seated parts, so as to avoid access of air, is as follows: pinch up a fold of the integuments covering the part to be operated upon, and enter a sharp-pointed knife more or less perpendicularly at the base of the fold; after the desired section has been made, withdraw the blade carefully, and allow the integuments to regain their proper position, then cover the opening in the skin as above directed. This is a convenient mode of opening chronic abscesses, when one does not wish to evacuate all the matter at once.

For more detailed instructions upon these matters, which we have not thought it necessary to furnish here, the reader may consult any good work on *Operative Surgery*, as Malgaigne's, Dr. Henry Smith's, or Mr. Fergusson's; from the latter, particularly, we have drawn most of the illustrations and suggestions contained in this short chapter.

CHAPTER II.

ON BLOODLETTING.

Blood may be drawn from a vein or artery of some size, constituting what is termed "general bleeding," or from the smallest vessels which ramify beneath the surface, by means of cups and leeches, "local bleeding." The former method of abstracting blood is practised when the amount to be drawn is considerable, or when a general depressing effect upon the system is desirable; the latter, when a particular part only of the economy is affected,—the system generally being little, or not at all, involved. Sometimes, however, the indications for resorting to both operations exist in the same case and at the same time: under such circumstances, both general and local bloodletting should be practised, the former from a vein, usually, the latter from the vicinity of the suffering organ.

In cities, these operations are generally performed by a class of persons who devote themselves to this duty as an occupation. In the country, the practitioner himself must attend to them. Every medical man, however, should be well acquainted with the methods of operating, and, whether he live in the city, or in the country, should be skilled in the practice of general bleeding, at least, since he will be often compelled to resort to it.

SECTION I.

ON THE OPERATIONS FOR GENERAL BLEEDING.

These consist in the opening of a vein or an artery; the former is much the most commonly practised, and should always be preferred, if a choice can be made. The incision of a vein is termed phlebotomy; that of an artery, arteriotomy.

Phlebotomy. — 1. One of the veins at the bend of the

arm is usually selected for bleeding, because these vessels are very superficial and convenient of access in this region, and are of sufficient size to allow the requisite amount of blood to escape freely and rapidly. The annexed drawings give a very good view of the veins of this region, as they are generally distributed, with their positions relatively to the artery and the superficial nerves (figs. 121 and 122). In figure 121 are

FIG. 121.



FIG. 122.



displayed: "1, the radial vein; 2, the cephalic vein; 3, the anterior ulnar vein; 4, the posterior ulnar vein; 5, the trunk formed by their union; 6, the basilic vein, piercing the deep fascia at 7; 8, the median vein; 9, a communicating branch between the deep veins of the fore-arm and the upper part of the median vein; 10, the median cephalic vein; 11, the median basilic; 12, a slight convexity of the deep fascia, formed by the brachial artery. This fascia is divided and turned aside in fig. 122, to show the brachial artery; 13, the process of fascia, derived from the tendon of the biceps muscle, and separating the median basilic vein from the bra-

chial artery; 14, the external cutaneous nerve, piercing the deep fascia and dividing into two branches which pass behind the median cephalic vein; 15, the internal cutaneous nerve, dividing into branches which pass in front of the median basilic vein; 16, the intercosto-humeral cutaneous nerve; 17, the spiral cutaneous nerve, a branch of the musculo-spiral." Druitt, p. 494.

The median cephalic and the median basilic veins are those in which the incision is generally practised in bleeding. The median basilic is the larger of the two, and would seem therefore to be the most proper for the operation, and it is also more superficial than the other; but the brachial artery is situated very near it, passing beneath it from the external side, and separated from it only by the thin aponeurosis from the tendon of the biceps muscle, so that an incision too deep would probably penetrate the artery as well as the vein, as has not unfrequently happened; moreover, this vein is crossed in front by several filaments of the internal cutaneous nerve, which, as they are invisible to the operator, are liable to be involved in his incision. Therefore it is safer to open the median cephalic vein, as this is remote from the artery; and as regards the liability of wounding one of the nervous filaments, the danger is rather less than in the other case, the external cutaneous nerve passing beneath it; the superior part of this vein, according to M. Lisfranc, is never crossed by nervous twigs. With regard to injury of the nerves in bleeding at the elbow, M. Velpeau says, that "all the veins at this part of the arm are surrounded by nervous filaments, and that with reference to this point, it would be ridiculous to open one in preference to any other." (Op. cit., p. 293.) Probably the best rule is, to bleed from the median cephalic vein, provided it is sufficiently large to allow the blood to flow with freedom. If the median basilic be selected, the incision should be made, if possible, either above or below the point at which the vein crosses the artery, and not directly over the latter, the artery becoming more deeply situated as it leaves the vein. Sometimes the artery runs parallel with this vein; in such cases the fore-arm should be forced into a state of pronation, so that the tendon of the biceps shall be made to intervene between the two.

In all cases, the operator should carefully examine the part

to see that there is no anomalous distribution of the arteries, and to guard against danger from this cause.

It often occurs that in females and in children, the veins are scarcely, if at all, visible, the adipose tissue being so abundant. Sometimes they may be made apparent, by allowing the ligature to compress the arm above the elbow for a considerable time, by plunging the fore-arm in warm water, by friction of the member, and by directing the patient to call the muscles of the hand and fore-arm into action. Generally, however, if the veins cannot be seen, they may be felt beneath the surface, like round elastic cords, not pulsating as the artery, and losing their prominent corded form, and their elasticity, when the compression is removed and the blood permitted to flow along its channels, regaining these characteristic marks when the pressure is resumed; the tendon of the biceps has been mistaken for a deep-seated vein, and has been cut in attempts to bleed; such an error ought never to occur, as apart from the criteria above mentioned for distinguishing a vein, the tendon may be easily recognized by flexing the fore-arm and marking the increased prominence which it thereby acquires.

Before opening the vein, the surgeon should procure, and have arranged in some convenient position, a narrow strip of muslin, or linen, with which to arrest the circulation in the veins of the fore-arm; a lancet; a vessel to receive the blood as it flows from the incision; a basin of water and a towel, to cleanse the surface after the operation; a small compress of linen folded, to be placed over the wound, and a narrow bandage of muslin, or linen, to retain this in place; smelling-salts, or some other restorative, should also be at hand.

The position of the patient during the operation is a matter of some consequence. If it is desirable to abstract a large quantity of blood, the recumbent posture should be assumed, as syncope occurs less speedily in this than in any other position; when a rapidly prostrating or relaxing effect is required, as in cases of hernia or dislocation of the hip, the patient should stand up while the blood is flowing; when an ordinary depletion only is indicated, and other circumstances permit of it, the sitting posture will be found the most convenient. The size of the opening, too, should be varied in different cases to meet particular views; as, for example,

when a prompt effect is desired, the incision should be long, to allow the blood to escape in a full current; a small opening should be made when a gradual influence is intended to be produced.

The choice of the arm on which to practise the operation may be left to the surgeon's discretion; sometimes the veins are larger in one arm than in the other, and their relative position with regard to the artery may be more favourable in one than in the other. If there be no reason of this kind for selecting the right arm, it will be better to bleed from the left, since, if any accident should happen, the injury is more easily submitted to in the latter than in the former.

Either the thumb-lancet, or the spring-lancet, may be used according to the habit or the fancy of the operator; some prefer one, some the other, and occasionally a patient is met with who has strong objections against one or the other. There seems to be great diversity of opinion concerning the comparative safety of the two instruments. It is urged in favour of the use of the spring-lancet, that the operation is done more instantaneously with it than with the other, and with less pain; and that it is less frequently attended with wound of the artery, in those cases in which the vein is entered at a point directly over this vessel; this last argument derives strong support from the statement of Dr. Reese, the American editor of Cooper's Surgical Dictionary, to the effect that aneurism of the brachial artery at the bend of the arm is much more commonly met with in the northern and eastern sections of this country, where the thumb-lancet is in general use, than in the southern and western and middle states, where the spring-lancet is employed very generally, and in many districts by very ignorant persons, as by the slaves on the southern plantations. The thumb-lancet is the most surgical instrument; when of the proper shape and in perfectly good order, as it always should be, the vein may be opened with sufficient quickness, and with no more pain than when the spring-lancet is employed; the size of the incision can be more nicely graduated with the former than with the latter, and a deep-seated vein may be more certainly reached with it: and as to the danger of penetrating the posterior wall of the vein and wounding the subjacent artery, if the thumb-lancet is used, the same amount of practice is as requisite to

enable the operator to determine just how far from, or how near to, the skin it is necessary to hold the fleam of the spring-lancet, in order that he may open the vein merely and not penetrate entirely through it, will render him capable of detecting, by the diminution in the resistance offered to the point of the thumb-lancet, the moment at which the cavity of the vessel has been entered by the instrument. It has occasionally happened in bleeding with the spring-lancet, that the fleam, or blade, of the instrument has been broken off, by the force of the spring, and has remained in the cavity of the vein, rendering it necessary in some instances to slit open the vessel as far as the first valve, in order to remove the lancet. This accident is of rare occurrence, but the possibility of such an incident should be borne in mind. The spring-lancet will be found the most convenient instrument in bleeding children, in consequence of the struggles which they usually make, and which interfere very much with the performance of the operation when the thumb-lancet is used.

The shape of the blade varies very much according to the fancy of the surgeon, or of his cutler; we would recommend one rather more oval-shaped at the point than that represented in fig. 123. The point and the edges of the instrument should be very sharp, and the blade as thin as is compatible with perfect strength and security. The lancet used for bleeding should never be employed for any other purpose, as cases have often occurred of inoculation of the wound with irritating or poisonous matters which have adhered to the blade. The instrument should be well cleansed and wiped dry after it has been in requisition, and kept in a suitable case.

Operation. — The operation is commenced by encircling the arm, at a point an inch or two above the elbow, by a piece of ribbon, or a strip of muslin, an inch and a half wide and a yard and a half long. The arm should be bared nearly to the shoulder, care being had that the sleeve of the patient's dress exercises no constriction about the limb, impeding the flow of the blood through the artery; then the surgeon, having carefully examined the bend of the arm, in order to ascertain the precise position of the brachial artery, and whether there be any anomalous distribution of the vessels, places the centre of the compressing bandage upon the

middle of the arm, at the point already indicated, carrying the tails around on each side successively, and bringing them up over the anterior face of the arm, to tie them in a single bow-knot on its outer side, the extremities of the band hanging downwards. The bandage should be applied sufficiently tight to arrest the course of the blood in the superficial veins, but not to interfere with the circulation in the artery. If, as is sometimes the case, the veins do not swell, the expedients before adverted to should be tried, and if these are ineffectual, the other arm should be taken, or a vein in some other part of the body may be opened, if it should be impossible to find a suitable vein in either arm. In such circumstances, M. Lisfranc advises that the cephalic vein should be exposed, where it occupies the interstice between the deltoid and pectoralis-major muscles, and an incision made in it. But there are few instances in which it is not possible to abstract the requisite amount of blood from one of the veins at the bend of the arm. The vein having been selected for the operation, and the exact situation of the artery with reference to it ascertained, the next step is to make the incision. It is of great importance that the patient's arm shall be well secured, in order to avoid any accident which might ensue from a sudden movement of the limb, as the instrument pierces the tissues; this is of less moment when the spring-lancet is employed, than if the thumb-lancet is used. When the latter instrument is selected, the operator will find it of much advantage to be equally skilful with his right and left hands, as he can secure the patient's arm, and perform the operation more satisfactorily. Thus, the arm should be thrown out from the body, and the surgeon should sit, or stand, between the limb and the side of the patient: if the right arm is to be operated upon, the elbow should be supported upon the outstretched fingers of the surgeon's left hand, his thumb pressing upon the vein, about an inch below the point of incision, in order to steady the vessel, and to prevent a too great out-gush of blood from soiling the clothes, while the patient's fore-arm and hand are extended beneath the left fore-arm of the operator, and thus securely held; the lancet is, of course, entered with the right hand: if a vein of the left arm is to be opened, the surgeon modifies his position, so as to secure the arm with his own right hand and arm, and holds the instrument in his

left hand. But if, as is the case with most persons, the operator cannot make the incision conveniently with his left hand, he must place himself on the outer side of the patient's left arm, securing the fore-arm with his own left, and open the vein with his right hand.

The blade of the lancet should be exposed so as to form a slightly obtuse angle with the handles, and held as is represented in the annexed drawing, (fig. 123,) being grasped near its head between the extremities of the surgeon's thumb and fore-finger, the handle resting against the latter. The operator places his middle finger upon the patient's fore-arm, as in the figure, so as to support the hand: the point of the lancet is entered perpendicularly to the surface, if the vein is deep-seated, but at a more obtuse angle if the vessel is more superficial; the mere straightening of the thumb and fore-finger serves to force the point of the instrument through the integuments and the anterior wall of the vein, when, so soon as the escape of blood and the cessation of resistance to the entrance of the blade make the surgeon aware that the point is within the cavity of the vessel, he depresses the handle of the instrument, and at the same time pushes it a little forwards by his thumb and fore-finger, until the incision has been made sufficiently long, when the blade is withdrawn; or it is perhaps safer to force the blade to cut its way out of the vein, so soon as the latter has been entered, by depressing the handle more and more, thus bringing the cutting edge in contact with the anterior wall of the vessel and with the integuments, successively: in this way there can be but little danger of penetrating the posterior coats of the vein with the point of the lancet. The incision should generally be somewhat oblique with regard to the axis of the vein, especially if the vessel be of small calibre, as otherwise the blood will escape more slowly.

Fig. 123.



If the spring-lancet is used, it should be held more or less

obliquely to the course of the vein, according as the vessel is of small or large calibre: when the vein to be opened is superficial, the point of the blade should be held a little above the skin, so that it shall simply enter the vessel, and not pierce entirely through it; if, on the contrary, the vein is more deeply seated, the point of the fleam should rest upon the surface. In bleeding from a vein which is directly over the artery, the incision should be made upon the side of the vessel, instead of its anterior face, as being less liable to penetrate to the artery itself.

If, after the incision has been made, the blood does not flow freely, the patient may be directed to grasp something in his hand, as a cane, closing and relaxing his fingers upon it alternately, thus compressing, by the contraction of the muscles, the deep veins, and forcing the blood into the more superficial channels; the current through the vein is sometimes impeded by a constriction of the artery, arising from the too tight application of the bandage, which should of course be loosened: again, it may occasionally happen that a shred of adipose tissue may obtrude itself across the incision, and thus obstruct the escape of the blood; the remedy for this difficulty will at once suggest itself to the operator. Syncope, accompanied by cessation of the flow, is at times produced by the dread of the operation which some persons experience, or by the sensation of the incision itself, or by the sight of the blood, in very sensitive patients; in such instances, smelling-salts should be applied to the nostrils, cold water be dashed upon the face, and the individual be placed in the recumbent position, until the faintness shall have passed off, when the blood will flow again, generally.

It is of little consequence what kind of vessel is employed to receive the blood as it escapes from the vein; a common bowl answers the purpose as well as any other: however, if it be desirable to fix precisely the amount to be abstracted, the "bleeding-cup" proper should be used,—a vessel having lines upon its inner side graduated to show the number of fluid-ounces which it may contain: such bowls may be had of most of the druggists.

After the required amount of blood has been drawn, the bandage should be removed from the arm; the edges of the incision approximated by the thumb and forefinger of the sur-

geon's left hand; the surface cleansed; the compress placed upon the wound, and retained in this position by the crossed bandage, as shown in figure 18. In applying the bandage, care should be had that it does not compress the arm above the opening in the vein more than below this point, otherwise the blood may again flow from the incision. After the lapse of twenty-four hours, during which time the patient should keep the elbow flexed, and avoid using the arm,—the bandage may be removed, as in most cases the orifice will have become sufficiently closed to prevent the escape of the blood.

If it be probable that it will be expedient to repeat the bleeding in the course of twenty-four hours, the necessity of opening another vein may be avoided by anointing the compress with fresh lard, so that the orifice made in the vein will close less speedily than when a dry compress is applied. It is requisite merely to remove the bandage and encircle the arm, just above the elbow, with a band, as in the first bleeding: if the blood does not escape, on the vein becoming turgid, the hand should be passed upwards along the vessel, when the fluid will generally burst through the imperfectly closed incision; if it do not, a fine probe may be used to re-open the wound.

2. Bleeding from the *hand.*

Operation.—Compress the fore-arm by a circular bandage applied just above the wrist, in order to render turgid the veins upon the back of the hand, and make an incision with a thumb-lancet into the largest of these vessels, in the same way as has been directed above with respect to the veins at the bend of the arm. The cephalic vein, formed by roots coming from about the thumb and fore-finger, and the vena salvatella, from the other fingers, are the largest trunks. Care is necessary that the incision be not made so deep as to perforate the vein and wound the subjacent tendons.

The wound, after the bleeding, should be covered as in the last-described operation.

3. Bleeding from the *ankle.*

Operation.—Plunge the foot in a basin of warm water, and allow it to remain until the veins running along the ankle shall have become swollen; then remove the foot from the water, dry it, pass a circular bandage around the leg just above the malleoli, and open the internal saphena vein near

the inner ankle, the vessel being fixed by the thumb of the left hand, placed just below the point of the intended incision. The opening should be oblique, and rather longer than is required for the veins of the fore-arm, so that the blood may have every facility for its free escape. After the incision, if the current do not flow readily, the foot should be again placed in the water, in which case the amount drawn must be judged of by the discoloration of the water, or by the effect produced upon the patient.

The operator should be careful to regulate the force with which he makes the incision according to the volume of the vein; otherwise, by penetrating too deeply, he incurs the liability of breaking the point of his lancet against the bone. The thumb-lancet should be used. The external saphena vein is sometimes opened at the outer ankle, but it is rarely so large as the other. The operation is performed as on the internal saphena.

The requisite amount of blood having been removed from the vessel, a small compress should be placed upon the incision, the surface cleansed, and a figure-8 bandage applied to retain the compress, circling around the leg and the foot, above and below the ankles, leaving the heel exposed, and crossing upon the instep.

4. Bleeding from *the external jugular.*

This operation is rarely performed, partly in consequence of the more or less danger attending it, but chiefly because the required amount of blood can generally be taken from a vein at the elbow. It is sometimes advisable, however, to practise this operation; as, for instance, in convulsions occurring in young children, in whom there is frequently much difficulty in bleeding from the arm; also in apoplectic seizures.

When it is determined to open the external jugular, the incision is usually made between the lower third of the vein and a point two inches above the clavicle. Below this point, there may be danger that the air will enter through the orifice to the heart, thus causing almost instant death. Above its lower third, the vein is so surrounded by nervous filaments that the incision of the former would, very probably, implicate the latter.

OPERATION.—The patient is placed in a sitting, or in the recumbent, posture; a thick compress should be laid upon the

vein in the supra-clavicular fossa, and retained in this position by a strip of muslin, or a cravat, which crosses the chest obliquely from this point to the axilla of the opposite side, where its tails are united, as in the accompanying drawing (fig. 124.)

Fig. 124.



In opening the vein, the surgeon places the thumb of his left hand upon the compress, and his forefinger upon the swollen vein, just above the point selected for the incision, and opens the vessel pretty freely in a line obliquely upwards and outwards, crossing the fibres of the platysma-myoid, so that the lips of the wound may be well separated. A tea-cup, or a small bleeding-bowl, should be held against the skin at the lower edge of the opening in the vein, to receive the blood as

it escapes: or if the current do not jet from the orifice, a card should be bent to the form of a gutter, or trough, to convey the fluid into the cup. The compression should not be intermitted until the operation is completed, and the opening in the vein closed by another compress placed upon the wound: this precaution is intended to prevent the ingress of air. The compress may be retained in place by short strips of adhesive plaster laid across it, or by the circular bandage of the neck, described under the head of regional bandages.

The escape of the blood may be facilitated, if it do not flow readily, by directing the patient to move the lower jaw, as in masticating. After the operation, difficulty is occasionally experienced in arresting the flow; under such circumstances the recumbent posture should be maintained, all compression from clothes carefully removed, and the patient be directed to breathe freely and fully. M. Magistel closes the wound, in such cases, with a fine suture.

ACCIDENTS ATTENDING PHLEBOTOMY.

Fortunately these are rare, when the frequency of the operation is considered, and those which occur most frequently are so slight in themselves and in their consequences, as hardly to merit the appellation of accidents; such are the formation of what is termed a thrombus, and syncope partial or complete. The proper remedies for the latter have been mentioned, in treating of bleeding from the arm. A thrombus is a tumour, or swelling, generally of small size, produced by the infiltration of blood into the cellular tissue surrounding the vein. It is owing, in most cases, to the external incision not corresponding exactly in situation with the opening in the vein, the correspondence having become destroyed by some movement of the arm, or by a want of attention on the part of the operator, while making the incision, to have the skin tense and smooth; any cause which will obstruct the ready escape of the blood from the vein to the external surface may develope a thrombus. Generally it is a matter of little consequence, giving rise only to some swelling, discoloration, and stiffness at the elbow, which inconveniences will disappear in a few days. Sometimes, however, if the effusion is large, the

fluid is removed by suppuration instead of by absorption, and there is danger that the vein will become involved in the inflammation.

The simpler cases of this incident to bleeding require very slight treatment; the removal of the effusion will be hastened by keeping the arm at rest and covering the affected part with soap-plaster, or a wash of diluted spirits of camphor, or of some similar resolvent. If inflammation and suppuration occur in the tumour, a splint should be confined upon the back of the arm and fore-arm, to maintain perfect repose of the tissues about the elbow, and leeches, cold lotions, irrigation, or poultices, should be made use of, according to the condition of the tumour.

By carefully watching the escape of the blood during the operation, the surgeon may often guard against, or arrest, the formation of a thrombus, by maintaining the parallelism between the wound in the integuments and that in the vein, or by restoring this condition if it has been deranged. If this correspondence cannot be regained, and the tumour increases in size, the external incision should be enlarged sufficiently to permit of the blood reaching it, or another vein should be opened.

Wound of a Nerve.—This accident may happen, and it has occurred to the most skilful operators in bleeding, and it cannot be considered as a subject of reproach. It will be recognised by some disturbance in the functions of the part to which the nerve is distributed. If the wounded nerve be a nerve of sensation, pain will be experienced at the seat of the incision, or at the terminal ramifications of the nerve, a sensation of numbness or of tingling, or the skin will be deprived of sensibility. If it be a motor nerve which has been implicated in the incision, the muscle, or muscles, to which it gives power will be more or less paralysed, or be the seat of irregular motor action, spasmodic twitches, tetanic rigidity, and the like.

This accident is a much more serious one than those already considered, and should be so regarded. The treatment consists in the application of antiphlogistic or anodyne remedies to the surface, according to the symptoms; in securing the limb to a splint in a semiflexed position, and in the administration of opiates internally. The limb should be kept in a

state of perfect rest on a splint, for two or three weeks, or so long as there is any probability of the reunion of the cut extremities of the nerve, experiments and observations having shown that restoration of the functions of nerves simply divided does take place. (Carpenter's Human Physiol.; Muller's Physiol. vol. i. p. 457, &c.)

WOUND OF AN ARTERY.—The brachial artery is the one most liable to be wounded in phlebotomy, and its accidental puncture may be taken as a type of similar injuries of other arteries. The signs usually mentioned as indicative of this accident are, the flowing of the blood in jets from the external opening, and the bright-red hue of the fluid. These appearances, however, are fallacious, for venous blood is not always of a dark blue colour; in fact, in many persons and in some diseases, its colour approaches very nearly to the hue of arterial blood; and if the vein which has been opened is seated immediately upon the brachial artery, the pulsations of this vessel will often agitate the vein, and communicate a jetting motion to the current as it escapes from the latter. The occurrence of the accident may be recognised pretty surely, by observing whether the blood continues to flow from the external wound, when the vein is compressed at the lower edge of the incision; if such is the case, the artery has probably been opened, the only circumstance likely to mislead the observer arising from the communication of another vein with the one in which the aperture has been made, opposite the orifice; this must be a very unusual incident. Additional knowledge may be acquired as to the non-existence of injury to the artery, by compressing this vessel at some point above the wound, when, if the colour of the blood remain as before, the inference from this fact, conjoined with the cessation of the flow when the vein is compressed below the orifice, while the artery still pulsates at the wrist, is, that only the vein has been opened. Again, if the external wound be closed with sufficient force to compress the vein merely without obliterating the artery, a gradually increasing tumour will be developed in the tissues, if the artery has been punctured. The existence of the injury having been ascertained, there can still be no impropriety in permitting the blood to escape until the amount originally intended to be drawn has been removed. Then the surgeon must determine whether it is better, in the

particular instance, to endeavour to remedy the accident by the long-continued employment of a compress and bandage, or to obliterate the artery at once by the application of a ligature, or ligatures. M. Velpeau recommends that the first method be tried for a week or two, unless some serious appearance present itself. (Velpeau, op. cit. p. 312.) This course having been determined upon, a graduated compress should be formed, of a pyramidal shape, and applied with its apex upon the wound, a figure-8 bandage being made to retain it in place with a degree of compressive force considerably greater than would be sufficient to obliterate the vein merely, so that the pulsation at the wrist shall be arrested (fig. 125); the limb, from the fingers to the axilla, should be enveloped carefully in a roller-bandage, and maintained in a state of perfect rest upon a splint, in the straight position; the patient should remain in bed, or his arm should be supported in a sling. If, after compression has been employed, the formation of an aneurism be detected, the treatment necessary for

FIG. 125.



PLAN OF A GRADUATED COMPRESS. — *a*, the artery wounded; *b*, *b*, the graduated compress arranged so that the apex of the cone is in immediate contact with the arterial orifice, while its mass occupies the general wound, and projects somewhat above the integumental level.

this affection must be adopted; for this, and for the best method of obliterating the artery by ligature, if the treatment by compression be rejected at first, the reader is referred to treatises on practical surgery.

WOUNDING OF THE TENDON OF THE BICEPS, OR OF OTHER MUSCLES.—It happens occasionally that one of the tendons is pricked by the point of the lancet, when it is seated beneath the vein which has been opened; or the operator may have mistaken the tendon for the vein, and plunged his lancet therein. Some degree of pain and difficulty in using the

muscle are generally experienced, after such an accident, but the symptoms are rarely of a violent character. The treatment consists in keeping the limb at rest upon a splint, the muscle being relaxed, and in the application of anodyne and emollient remedies. In irritable patients, it may be advisable to abstract blood from the part, by leeches, and to administer opiates.

ARTERIOTOMY.

The temporal artery is the only one upon which this operation is now practised, and very rarely is it considered advisable, even on this vessel. The artery is superficial, is favourably situated for compression after the operation, and is generally large enough to allow of the abstraction of a sufficient amount of blood. Although the incision of the vessel is one of the simplest of operations, it is sometimes followed by the development of an aneurism.

A strong lancet, or a bistoury,—a graduated compress,—a narrow roller, two or three yards long, — warm water and a towel, are all that are usually needed for the operation.

The trunk of the temporal artery itself, or its anterior branch, may be opened; if the former, the mode recommended by M. Magistel may be resorted to, as follows:— The position of the trunk is ascertained at the point where it is most superficial, and where its pulsation is most forcible, and there marked with ink in the direction of the intended incision: this point will be found a little in advance of the ear, and above the zygomatic arch. The patient may sit up, or assume the recumbent position, his head resting upon a pillow on the opposite temple; the surgeon steadies the artery by one finger placed upon the surface, on the outside of the vessel, and about a quarter of an inch above the site of the intended incision; the bistoury is held as the lancet in phlebotomy, and entered through the integuments on the inner side of the artery, cutting its way obliquely through the vessel and the integuments of the opposite side. The blood is received directly in a cup, or it is guided to the latter through a little gutter of paper, placed against the surface beneath the opening: a plug of cotton should be inserted into the chamber of the external ear, to prevent the blood

from entering it. When the proper amount has been drawn, the flow is generally easily arrested by placing a small compress of folded linen upon the orifice, (its lips having been placed in apposition,) and securing it thus by a few circular turns of a roller. If this be insufficient to stop the bleeding, a fine suture may be passed through the edges of the wound. (Malgaigne, Méd. Opérat.)

If the blood do not flow freely, the patient, if he be conscious, should be requested to move his jaw, as in mastication, or a sponge filled with warm water may be laid upon the vessel.

M. Velpeau advises that one of the branches of the artery be selected for the operation, particularly the anterior branch in its course towards the forehead, as it is very superficial, and reposes so nearly upon the bone, that a firm compression may be made upon it. The mode of performing the operation is the same as for the trunk itself: the lancet may be used as in opening a vein, or a bistoury may be employed, and the integuments and vessel divided, from the former towards the latter, and from the outer side of the artery towards the operator. See fig. 124.

SECTION II.

ON TOPICAL BLEEDING.

1. On the application of the cupping apparatus.

In professional language, "*a cup*" is a small, bell-shaped vessel, made of glass, or thin metal, intended for application to the surface of the body, with the view either of removing a certain amount of blood from the minute veins and arteries which have been previously incised, or of merely producing a congestion of the surface, or a certain degree of ecchymosis. The first is termed "wet-cupping," or simply "cupping," the latter "dry-cupping."

Dry cupping is effected by merely acting upon the air within the cup, so that the integuments, on the surface of which it is placed, shall be forced, by the pressure of the atmosphere without, into the partial vacuum formed within the vessel. This vacuum may be produced in several differ-

ent ways, either by means of heat so applied as to rarefy the air within the enclosure, or by the direct abstraction of a certain portion of it through the aid of a pump. The latter is the most convenient and the most eligible mode. The pump is made to fit upon the summit of the cup, which is perforated with a small hole covered with a thin valve of oil-silk, or of gum-elastic, to exclude the entrance of air from without; while, by the action of the pump, a very considerable exhaustion can be effected within the cup. The cup is best made of glass, so that the degree of turgescence of the integuments can be seen; when this is deemed sufficient, the glass is easily detached from the surface by slightly raising the valve by means of a pin inserted beneath it, when the pressure of the atmosphere within and without the cup will become equalized.

If this complete cupping apparatus be not at command, the operation may be sufficiently well performed by using a common wine-glass, or tumbler. The vessel may be immersed in hot water, in order to heat its surface, and then, before it becomes cooled, applied upon the skin; thus the air which it contains becomes rarefied by the heat of the material of which the cupping vessel is composed, and retreats before the ascent of the integuments, which are pressed upwards by the weight of the air surrounding the cup; or the inner surface of the cup may be moistened with spirits of wine, which should then be inflamed, and while the vessel is yet warm, it should be placed upon the skin; or, finally, small pellets of cotton, or strips of paper, may be moistened with the same fluid, then lighted and introduced into the cup, which is used as above. The vessel may be loosened from the surface after a proper time, by pressing upon the integuments at its edge, so that the air may rush into the cavity.

Dry cupping will be found of great benefit in the relief of internal congestions, when it is not expedient to abstract blood. It seems not to produce its good effect by revulsion merely, or by the external irritation which it causes, but also by rendering the vessels on the surface turgid, producing a true ecchymosis, and thereby diminishing temporarily the amount of fluid in circulation through the vessels.

Wet cupping requires that, in addition to the local turgescence which the dry cupping occasions, the surface thus

engorged shall be incised, its small vessels opened, and blood be abstracted therefrom. To accomplish this object, the cupping apparatus must be used as above described, and after the integuments have become sufficiently full of blood, the cup should be removed and a number of incisions made on the surface, deep enough to open the subcutaneous vessels; then the cup is to be re-applied, and the air again exhausted from it; thus the blood will flow readily from the openings made. After a sufficient amount has been obtained, the cup is removed and the surface cleansed; generally, no dressing is called for, but if there be much smarting, cold or warm water, or a piece of linen spread with simple cerate, may be applied, as may be most agreeable to the patient. In directing the use of cups, it is generally considered that each one will draw one ounce of blood; this is not strictly correct, as the amount will vary very much, according to the vascularity of the part to which the application is made; sometimes a single cup will abstract several ounces if re-applied to the same spot, and again but a very small proportion of this amount can be taken. The flow of blood may be encouraged by immersing the cup, before it is placed upon the skin, in warm water, and by laying a sponge or towels dipped in warm water upon the surface, while the cup is acting. The depth of the incision must be regulated to suit the character of the surface; where the integuments are thick, containing much adipose tissue, the incisions must be deeper than under opposite circumstances. The proper instrument for making the incisions in cupping is the "scarificator,"—a metallic box of about the same size as the cup, having its interior surface pierced with a number of slits, through each of which a lancet-blade is made to protrude by means of a spring, the frame upon which the blades are secured being elevated or depressed, so as to regulate the depth of the incisions, by the turning of a screw arranged for the purpose. In the absence of this scarificator, the necessary incisions may be made by a scalpel, or a thumb-lancet; they may be parallel to each other, or crossed, or have an oblique direction.

The operation of cupping is sometimes a painful one, particularly upon surfaces not very well cushioned by integument, as on the chest of thin persons, and also when performed over inflamed cavities, as upon the abdomen in gastritis, en-

teritis, or peritonitis; but even in these latter cases, the operation may be effected with comparatively little pain, by first applying a poultice, or a fomentation, upon the surface; thus the sensibility of the part becomes lessened. This is a matter of considerable consequence, as leeches cannot always be obtained in all situations; and by the simple precaution just stated, cups may be very well used instead, in numerous instances in which, otherwise, the advantages of local depletion must be foregone.

It is of importance to bear in mind that the benefit of cupping does not consist in the local abstraction of blood merely, but also in the stimulation which it effects upon the surface to which the cups are applied, and in the revulsive action which is thereby occasioned.

2. On the employment of leeches.

There are many cases demanding local depletion, in which, from peculiarity of situation, or excessive sensitiveness of the surface, cups cannot be employed; in such instances, leeches may be used, as also in all other conditions requiring the topical abstraction of blood.

Previous to the application of the leech, the surface on which it is to be placed should be cleansed with warm water, so as to remove, as far as possible, any matter which may adhere to the skin, either as the result of medicinal applications, or as incident to the natural or diseased processes going on in the part: if this precaution be not taken, much difficulty and delay will be experienced in inducing the leech to fasten upon the surface, and the animal itself may be injured or killed, by the introduction into his system of such noxious matter. If the surface to be leeched be covered at all thickly with hair, as the pubis, the scalp, &c., it should be shaved before the leech is applied to it. When a number of leeches are to be applied to a circumscribed part, it is often found difficult to confine them within a sufficiently restricted range, if they are simply placed on the surface; this may be overcome by moistening the skin, at different points, with blood drawn from the tip of the finger, or with sugar and water; or the leeches, as many as are intended to be employed, may be put into a tumbler, or wineglass, which should then be inverted upon the skin; or, finally, the palm of the hand may be covered with a napkin, and the leeches placed upon the

latter, and thus held against the surface until they shall have attached themselves. When blood is to be taken from the mucous membrane lining a canal, it is necessary to place the leech in a tube, which is then to be introduced into the canal, its open extremity applied to the membrane at the proper point, and there retained until the leech has fastened itself upon the surface. Thus if the depletion is to be effected from the neck of the uterus, the neck of the bladder, or from any part of the vagina, in the female,—a speculum of polished metal, made of a single piece, and having the upper end cut obliquely, should be introduced into this passage to the proper distance, the polished internal face of the speculum enabling the operator to see each point of the vagina; the leeches are now to be placed in the speculum, and thrust up to the affected spot by means of a quill, or a stick. For the rectum, a smaller speculum is required. For the nostrils, a tube of glass slightly curved at its upper extremity, and about a quarter of an inch in diameter, gradually tapering downwards towards the curve, may be used; this should be introduced, and the point of the curvature carried opposite the spot upon which the leech is to be attached; the animal is then to be placed in the cavity, and pushed upwards by means of a quill, or a pencil; as soon as it has fastened upon the membrane, the tube may be withdrawn, and, if necessary, another leech introduced in the same way. A similar plan should be adopted in the application of leeches to the gums, or to the lining membrane of the mouth at other points.

If, accidentally, one or more of these animals should escape beyond the reach of the operator, as into the stomach or rectum, it may be destroyed by injecting a solution of salt into the cavity; afterwards the leech will be discharged dead.

Repletion causes the leech to fall from the surface upon which it had fastened; but if it be expedient to detach it before it has become filled, fine salt should be placed upon it; it should not be violently pulled from its hold upon the skin, lest a portion of its mouth remain in the little wound which it has made, causing more or less irritation and destroying the animal.

The quantity of blood which a leech will draw varies very much with the kind of leech used, and the degree of vascularity of the surface. Six of the ordinary American leeches

are allowed for each ounce of blood required; these answer very well for application to the external surface, in situations possessing an average condition of the circulation, and offering space sufficient to allow of the application of the requisite number; their bite is less irritating and less deep than that of the European leech, and hence they should always be employed upon children, and upon others whose skin is prone to a morbid degree of inflammation or soreness, from slight causes. An ounce of blood is generally allotted, as the capacity of two or three Swedish, or Spanish, leeches. These are used when the part to be depleted is endowed with little vascularity, and upon internal surfaces of which the secretions are naturally, or from disease, more or less acrid or offensive to the animal, as the mucous membrane of the vagina, that covering the neck of the uterus, the rectum, the gums; and it is advisable always, before applying the leech to such parts, to wash them with warm water.

After the animal has fallen off, the blood continues to flow from the wound, but this ceases in the course of a few minutes, if the bite be left exposed to the air, unless a small arterial branch of notable size has been opened. If a sufficient depletion has been had, and the bleeding does not cease of itself, cold water should be laid upon the surface, or dry lint; and if anything more effectual is necessary, pressure with the finger, a little fine lint intervening between its point and the leech-bite, may be made upon the latter for a few minutes, and then the finger gently withdrawn, leaving the lint behind; this will generally be sufficient to arrest the bleeding; but if this fail, a fine point of lunar-caustic should be thrust into each bleeding wound, and quickly removed; finally, it is recommended, in obstinate cases of such hemorrhage, to pass a fine needle transversely through the lips of the wound, and to lay upon it a twisted suture; this, however, must be very seldom required.

If it be deemed expedient to encourage the flowing of the blood, warm water should be laid upon the part, or a warm poultice.

The preservation of the leech is a matter of great importance. To insure this object, the habits of the animal should be ascertained, in order that it may be placed in circumstances in which these habits and instincts may still be indulged.

It should be kept in some suitable vessel, — an ordinary tub will answer,—containing water, and pieces of turf, or, which is still better, of peat, into which the animal may insinuate itself, and, by the friction of its surface against the interlaced roots of which the peat is composed, cleanse itself of the slimy secretion which covers it, and which, if permitted to remain long upon the exterior, prevents the proper performance of certain functions on which the health of the leech depends. The water moreover should be changed as often as once every week, and the leeches should be washed, unless they have the means, as above described, of performing this office for themselves. The animal obtains its supply of oxygen from the air entangled in the water, and not by rising to the surface to breathe.

In this way leeches may be preserved for an indefinite length of time, until needed for application; but after they have been once employed in drawing blood, they never are so efficacious again. If they have been applied to abstract blood from persons suffering from some malignant or contagious disease, they should not be used subsequently.

The natural food of the leech consists of smaller aquatic animals which it meets with in its native haunts; and the admirable apparatus with which it is provided, and which adapts it so perfectly to the purpose to which it is made subservient in the treatment of disease, would seem to be contrived for the especial benefit of man, — to be, in a measure, an appendix to the animal, and not called for in the operations of its own economy. Hence, although the blood with which it fills itself to distension, in the gratification of its voracious thirst, does not putrefy in the animal's stomach, notwithstanding the length of time during which it will be retained in this cavity, unless it be evacuated artificially,—in most cases, the animal will die unless the blood be removed from it. (T. Rymer Jones's Comparative Anatomy.) To accomplish this, it is requisite merely to place some fine salt, or salt water, upon the leech, which will cause the animal to eject the contents of its stomach by the mouth. The author is informed by Mr. Moore, who is one of the best leechers in this city, that he effects the removal of the blood by making one or two small punctures on the back of the leech, on each side of the middle line; the contents of the stomach and of

the numerous sacciform appendages to this central cavity are evacuated through these punctures, which soon close again without having injured the animal at all. Mr. Moore prefers this method to the use of salt, which he thinks is in some measure hurtful to the leech. Leeches which have thus been emptied of the blood that they have drawn, should be placed in a vessel containing water and turf, as above mentioned, and kept distinct from others for two or three weeks, after which they may again be employed.

Within a few years past, "*artificial leeches*," as they are called, have been introduced. These are small tube-shaped cupping-glasses; their diminutive size permits them to be applied where the ordinary cupping-glass could not be placed. They are not comparable to leeches as a means of abstracting blood from certain parts; but they may prove serviceable under circumstances when leeches cannot be procured.

Simple scarification of the surface with a lancet or scalpel, is sometimes resorted to as a means of local depletion. It can only be employed on very vascular parts, as on the tongue, the mucous membrane lining the interior of the mouth, and that covering the fauces and the eyelids.

CHAPTER III.

ON THE DIFFERENT MODES OF EFFECTING CUTANEOUS IRRITATION.

It has long been an established principle in medicine, that when a point of irritation exists in any part of the body, there will be a corresponding accumulation at that point of organic energy and of circulating blood; and the physical and chemical changes which accompany every manifestation of organic action will be proportionately more rapid and complete. To admit of this concentration of vitality upon a particular part of the body, the system elsewhere seems to suffer, as it were, a transfer of some portion of the vital energy allotted to it. Hence the resort to counter-irritation, or revulsion, in the treatment of disease: an exaltation of life is artificially occasioned in a particular part of the surface, with the view of diminishing or annulling the same condition, as the result of disease, in another and generally neighbouring organ. By properly varying the means resorted to, the kind and degree of action thus established may be suited to the different states which it is the object of the surgeon to counteract. These means are chiefly rubefacients, vesicatories, and such as produce suppuration.

SECTION I.

OF RUBEFACIENTS.

These are applications which excite an erythematous inflammation of the skin, terminating in complete resolution, and followed frequently by desquamation of the cuticle upon which they were placed. Their local action is strictly counter-irritant, not combined with any depletory influence; but, in addition to this, they produce a considerable degree of general excitement.

There are many applications which produce this effect: water, sand contained in a suitable vessel, and heated to a temperature somewhat above that of the surface of the body (from 100° to 150°), will excite an erythema of the skin; the same result follows the application to the surface of the aromatic oils and powders, of spirits of turpentine, dilute aqua ammoniæ, the "linimentum cantharidis," and many other substances. But the means most commonly employed as rubefacients are sinapisms, or poultices made of ground mustard-seed. In order to prepare the flour for application, it should be mixed with water, and spread evenly upon a piece of muslin, having the surface which is to be placed next the skin covered with a piece of thin gauze or cambric. The efficacy and rapidity of action of the sinapism may be increased, by adding vinegar to the flour, instead of using water, and also by incorporating it with a mixture of oil of turpentine and water. This applies only to the white mustard-seed powder.

The length of time during which a sinapism should be allowed to remain in contact with the skin depends, in a measure, upon the sensitiveness of the surface, and the patient's general sensibility. In the course of a few minutes after the application has been made, a sensation of warmth is induced, which becomes more and more powerful, so that after the lapse of twenty minutes it cannot be tolerated, generally, with any degree of comfort. It should now be removed, and reapplied at intervals, upon the same part, or upon other regions, as may be indicated. If it be suffered to vesicate the skin, a very troublesome sore often results, and sometimes gangrene, from excessive inflammation. Attention to the duration of the application is particularly necessary when the patient is unconscious, or only partially sensible, as the pain arising from the action of the mustard, in ordinary circumstances, is not complained of now, and great inflammation may be caused before this effect is suspected. By combining some other kind of meal with that of the mustard-seed, a poultice may be made, which will excite erythema more slowly, and which may be borne upon the skin for a much longer time.

The ordinary "spice poultice,"—made by mixing together the powders of several of the aromatics, as cinnamon, cloves, red and black pepper, and mustard-seed, together with wheat

or flaxseed meal, or bread-crumbs softened in milk or water, —is an excellent and mild rubefacient application. From a half teaspoonful to a teaspoonful of each of the aromatic powders may be combined with a sufficient quantity of one of the other substances, to make the poultice large enough for the surface to be covered.

The general stimulant or excitant action of rubefacients should be borne in mind when their application is directed, as in many cases this influence will be sufficient to counteract their revulsive effect.

SECTION II.

OF VESICANTS.

These are characterized by the effusion of serum beneath the cuticle, caused by the inflammation arising from their application. Hence, in addition to their derivative effect from the diseased organ, and the general excitement which they occasion, they act also as depletants: this last peculiarity serves to counteract the injurious impression which would otherwise be incident oftentimes to their stimulant action.

Vesication may be produced by a variety of applications. If a very rapid effect is desired, probably the best mode is to saturate a cloth, folded to the proper size, in boiling water, and lay it upon the surface, taking care that the fluid does not flow over a larger space than was intended. A piece of metal, raised to a high temperature by being plunged in boiling water, and then placed in contact with the skin;—or, according to the recommendation of Carlisle, metal heated to redness and passed over the surface, a fold of wetted cloth intervening;—or a jet of steam from the nose of some convenient vessel;—all these are at times resorted to for the purpose of raising a blister speedily. But they cause a degree of inflammation which often eventuates in gangrene, and are always very painful remedial agents.

There are three remedies of this class which are simple in their application and very manageable, and with which, probably, the surgeon may accomplish all that he can hope to

gain from the use of vesicating applications. These are the Spanish fly, Croton oil, and aqua ammoniæ.

1st. The cerate made of Spanish flies,—"ceratum cantharidis" of the Pharmacopœia,—is the preparation which is most used. It may be spread on coarse brown paper, or on soft leather, or, which is much the most convenient and most elegant substance, upon a piece of adhesive plaster, as it is prepared on sheets of linen for use. In covering either of these substances with the cerate, a margin should be left all around free from the salve. If the adhesive plaster is used, it will be necessary merely to warm this margin, in order to make the vesicating agent adhere to the skin on which it is placed: if any other substance is employed on which to spread the cerate, strips of adhesive plaster should be used to retain it on the surface.

Before applying the vesicatory, the skin should be shaved, if there be much hair upon it, and moistened with vinegar, in order to increase the rapidity of action of the flies; and it is also advisable to cover the surface of the cerate with a piece of fine tissue-paper moistened with vinegar, as by this means none of the blistering matter will adhere to the skin after the removal of the cerate.

The length of time during which the application should be continued varies with the part to which it is confined, the age of the patient, and the state of the general sensibility of the individual: probably from two to twelve hours may be assumed as the minimum and maximum duration. The scalp being much more tardy in responding to the action of the vesicant than any other part of the body, the application should be retained longer upon it. It is not necessary to the formation of the blister that serum should actually be effused beneath the cuticle before the vesicating agent can be removed. If the skin be rendered of a bright red colour by the action of the flies, these may be withdrawn, and a piece of linen covered with simple cerate, or a poultice, may be laid upon it, and in a short time the cuticle will be raised by the serum poured out beneath it: excepting in some few cases, where a very powerful impression is demanded, the desired results will be obtained from this course as fully as though the vesicatory had been retained upon the part for a much longer time; and this will be found to be the surest way of

preventing the occurrence of strangury, one of the most unpleasant incidents to the use of the Spanish fly as a blistering application. In children this method should always be pursued, the cerate being kept upon the skin for two or three hours only, and then it will be rare that gangrene, or a very high degree of inflammation, will endanger the life which the blister has perhaps rescued from the grasp of some formidable disease.

A very elegant and convenient preparation of cantharides is the "*cantharidal collodion*," as it is called; it is made by dissolving gun-cotton in an ethereal solution of cantharides. It is applied upon the skin by means of a camel's-hair pencil. It is prompt in its action, and the intensity of its effects may be pretty well regulated by the manner in which it is used. To produce a very speedy and comparatively severe vesication, a thick coating of the solution should be applied, and then covered with oiled-silk.

The mode of dressing the blistered surface will depend upon the effect which is desired. If it be not important to encourage a continued secretion or discharge from the skin, the cuticle should be simply punctured with a needle, or with the point of a thumb-lancet, and the serum be suffered to escape, and simple cerate, or a soft poultice, be subsequently laid upon the surface; in a day or two the irritation will have subsided. But if a continuation of the secretion be desired, the cuticle should be removed, having been first cut around its adherent edge, and the exposed surface of the true skin dressed with basilicon cerate, or with savine cerate. If, as is sometimes the case, the surface be very painful and much inflamed, a soft poultice or cold water will be found the best dressing. A sloughy condition of the part will be best combated by the application of one of the acids sufficiently diluted, or creasote, or decoction of oak-bark, or the solution of Labarraque, together with the internal administration of suitable tonics. When a blistered surface is tardy in healing, Dr. Wood strongly recommends the application to it of "the cerate of subacetate of lead diluted with an equal weight of simple cerate."

Blisters should always be dressed with great gentleness, as every one will feel who has had the misfortune to have been

blistered. The tearing off the cuticle, recommended by some, is a barbarity.

If strangury should occur, despite the precautions having been taken to prevent it, as above recommended, the patient may drink pretty freely of flaxseed tea, or if copious draughts of liquids be objectionable from particular circumstances, speedy relief will follow an enema of a scruple of camphor and twenty or thirty drops of laudanum suspended in an ounce or two of water or mucilage.

The affections strictly surgical, in which blistering by this means is most efficacious, are, probably, periostitis—the blister being produced directly over the seat of pain;—fractures remaining long ununited—where the blister is created in order to excite the vessels of the bone and surrounding soft parts to an increased activity of function, with the hope of repairing the injury;—erysipelas—in order to produce a more healthy kind of inflammation, and thus to arrest the spread of the disease;—and gangrene,—the object being the same as in the last affection. Besides these, many others may be enumerated as being more or less benefited by the employment of vesicating remedies, such as caries, the various ophthalmic diseases, neuralgia, chronic articular inflammations, indolent glandular and other swellings.

The general excitant effect of this class is one of the most important therapeutic characteristics, more marked in this than in the class last considered.

2. Croton oil—the "Oleum Tiglii" of the Pharmacopœia—is a very mild and manageable counter-irritant. It is more adapted to chronic than to acute diseases; its general stimulating effect is much less than that of cantharides, and its depleting action is comparatively slight; as a local derivative, however, it exerts a decided impression, and this may be maintained for a long time with less inconvenience to the patient than by the employment of the Spanish fly.

The effect of Croton oil may be obtained either by frictions, or by the incorporation of the oil with some sort of plaster, so that the compound may be spread upon a suitable substance, as leather, and worn upon the surface of the body. The first is the method usually adopted, as vesication is occasioned more speedily by this than by the plaster. The oil should be diluted with one or two parts of olive oil, or it may

be used in its concentrated strength, as the skin upon which it is to be rubbed is more or less tender, and as a less or more rapid action is desired. It is common to moisten a piece of flannel with a few drops of the oil, and to rub it over the surface until the skin is decidedly reddened and made to smart; this operation should be repeated after an interval of six or eight hours, and a third time, if necessary; two or three applications will generally be sufficient, unless the oil has been much diluted. The vesicles are numerous, sometimes coalescing, sometimes remaining distinct, each one being surrounded by a red areola, which, if the vesicles are near together, give the skin a uniform erythematous injection. The fluid is at first clear, but soon becomes turbid and puruloid. The irritation subsides after a few days, when the application may be renewed, if indicated.

If the other method of employing the oil be adopted, as recommended by Dr. Graves, of Dublin, it may be incorporated with lead-plaster, in the proportion of ʒj. of the oil, to ʒij. or ʒiij. of the plaster, and spread upon kid; or Burgundy-pitch may be substituted for the lead-plaster. This application will produce a vesicular eruption after it has been worn upon the surface for a day or two.

In using the Croton oil, it should be recollected that an irritation of the skin will be produced wherever the oil shall happen to come in contact with it, as on the eyelids and face from accidentally touching these parts with the fingers on which a little of the oil has remained; the consequent burning sensation and swelling are soon relieved by the application of cold water.

3. The strong water of ammonia — "Ammoniæ liquor fortior,"—may be used when a very rapidly vesicating agent is needed. It is applied by saturating with it a piece of linen folded to the proper size, and laying it upon the surface to be blistered, where it should be confined for two or three minutes, care being had that the liquid does not flow upon the surrounding skin.

The blistering lotion of Granville contains this preparation of ammonia as its active agent. He directs two lotions of different powers; these are prepared thus:

Strongest water of Ammonia	℥ss	and	℥ss
Distilled spirit of Rosemary	℥ij	"	℥ij
Spirit of Camphor	℥ij	"	℥ij

"The stronger lotion has been employed by Dr. Granville only in cases of apoplexy and for the purpose of cauterization. The first two ingredients are to be gradually mixed: whereupon the mixture becomes opalescent and gives out an ethereal smell. Before the addition of the third ingredient, the mixture should be rendered transparent by means of a little alcohol. These lotions are stated to produce as full a vesication in a space of time varying from three to ten minutes, as can be produced by cantharides in as many hours. They are applied by means of folds of linen impregnated with them." (U. S. Dispensatory, art. "Ammon. Liq. fort.")

They are used chiefly to relieve violent neuralgic pains.

SECTION III.

OF SUPPURATIVE COUNTER-IRRITANTS.

The remedies of this class act less promptly than rubefacients, or vesicants, but when the secretion of pus which is excited by them has become established, they produce a more depressing effect, inasmuch as the development and continuance of a suppurative discharge involve a greater expenditure of vital energy than is called for to produce an erythema, or a vesication. Any application which will cause a loss of substance of the surface on which it is made to act, will occasion suppuration from the granulations by which the reparation of the tissues is accomplished. Thus the strong mineral acids, the actual cautery, even a vesicant if it produce a sufficiently high degree of inflammation, will give rise to suppuration. The substances most employed with this view, however, are, tartar emetic, caustic potassa, nitrate of silver, the seton, the issue, and the moxa.

1. Tartar emetic is most frequently used in the form of the ointment made by incorporating the salt with lard, in varying proportions according to the strength required: one part of tartar emetic to two parts of lard makes a powerful ointment; a more common proportion is one of the former to four, or even eight, of the latter. The strong ointment will produce pustulation in the course of a few hours.

The mode of using this agent is, to rub a portion of the

preparation upon the skin for some minutes, until pain and redness are excited; if a single application be not sufficient, it should be repeated at intervals of a few hours. Suppuration from the ulcers thus induced should be favoured by dressings of some stimulating cerate, or by poultices.

A saturated solution of tartar emetic in warm water, to be rubbed upon the skin by the aid of a piece of flannel, is a very neat and cleanly method of producing pustular inflammation. Another, and a very convenient mode of using this agent is, to sprinkle a little of the powder upon the surface of a Burgundy pitch, or other adhesive plaster, which is then laid upon the skin, and there retained until pustules are developed.

2. Nitrate of silver, commonly called lunar caustic, produces an eschar much less deep than tartar emetic, and consequently is a less powerful application than the other. It is used by moistening a stick of the caustic and rubbing it upon the skin. As a caustic, it is employed to cause a superficial slough which, when it has become detached, leaves a healthy granulating surface, as in the treatment of chancre, and old ulcers.

3. Caustic potassa, prepared in the form of "sticks," is a much more effectual pustulating application than the last. With this, the tissues may be destroyed to almost any extent and depth, and great care is therefore necessary in making use of it. The best and safest plan is, to lay upon the skin a piece of kid, in which a hole is cut corresponding in size and situation with the portion of the skin on which the caustic is intended to act; then the potassa, slightly moistened, is to be placed, or rubbed, upon the skin thus exposed, until a sufficiently thick eschar is produced, after which it is advisable to pour a little vinegar upon the part, in order to render inactive any portion of the caustic which may still adhere to the tissues. The separation of the slough, thus produced, should be hastened by the application of warm poultices, and the granulating surface, left exposed after the detachment of the eschar, should be dressed with slightly stimulating lotions, or cerates, to encourage the secretion of pus.

The "Vienna paste," recommended by surgeons on the continent of Europe, is made by triturating together, with the aid of a little alcohol, five parts of caustic potassa and six

parts of quick-lime. The compound is used in the same manner as the caustic potassa alone, and produces an eschar in a few minutes, with less pain than the other.

A paste, made by incorporating chloride of zinc with wheat flour and water, is recommended by many surgeons as a caustic. M. Canquoin prepares it of different strengths, according to the desired effect; thus, he triturates one part of chloride of zinc with two, three, four, or five parts of flour, adding fifteen drops of water for every ounce of the flour. The paste thus formed is divided into cakes, varying in thickness from one-twelfth to one-third of an inch, and applied to the part; the eschar which it causes may be from one line to an inch and a half deep, according to the thickness of the portion of caustic, the duration of its application, and the character of the tissue to which it is applied. (U. S. Dispens.)

The white oxide of arsenic is now rarely used as a caustic: its application is generally attended with great pain, and unpleasant constitutional effects have often followed it.

Iron heated to whiteness has been, in earlier times, much resorted to as a means of producing a slough and subsequent suppuration. It is now, however, seldom employed for this purpose. When used thus, the iron is called "the *actual cautery*," in contradistinction from the other caustics, to which the term, *potential cauteries*, has been applied.

4. The moxa, as it is ordinarily used, consists of a cylinder of carded cotton, about an inch long and from one to two inches in diameter, the whole wrapped in a piece of linen and impregnated with a saturated solution of nitrate of potassa, or of chromate of potassa. To apply it, one of the extremities of the cylinder should be lighted in the flame of a lamp, and the other placed upon the skin, the roll being beheld between the blades of a pair of dressing-forceps. The moxa is maintained in a state of ignition by blowing upon it with the mouth, through a blow-pipe, or with the lips merely, the object being to secure a steady heat. The pain experienced from this application becomes gradually more and more severe, until the sensitive structure of the skin is destroyed, when it ceases. A thick eschar is thus formed, which, by the continued application of emollients, becomes detached after some days, leaving a granulating, suppurating surface, requiring dressings suitable for such a condition.

The moxa is generally employed as a counter-irritant in diseases of the bones, as caries of the spine, and is applied near to the seat of the affection,—not so near, however, as to involve the vessels and nerves in the slough which is formed.

5. Issues are established by the introduction into the subcutaneous tissue of some foreign body which acts as an irritant, and thus perpetuates a suppurative secretion. The substance generally used for this purpose is made of cork, or pine wood, or indeed of any similar material, cut to about the size and shape of the common garden-pea. It is introduced into the tissue either by an incision made with the knife, or it may be confined by means of strips of adhesive plaster upon the granulating surface, produced by the action of caustic potassa, or a vesicating agent.

There is some choice as to the point at which the issue should be established; it may be directly over the seat of the disease, or, if this be not important, at some remote point. The arm and the back of the neck are the most convenient situations for the formation of an issue; in the former, the pea should be introduced in the space between the biceps and deltoid muscles, near the insertion of the latter. When the neck is selected, any point may be taken which seems most convenient; it should generally be low down, so that the patient's dress may conceal it from view.

6. Setons are established by passing a piece of tape, or a skein of silk, or other similar material, through a portion of the integuments, and leaving it to excite suppuration. The seton may be introduced by means of the instrument contrived by Boyer for the purpose,—a blade shaped somewhat like that of the thumb-lancet, but stronger and curved also, and having an eye cut in its heel, through which the seton-tape, or silk, is passed (fig. 126);—or it may be effected simply by using a common bistoury and an eyed-probe. In either case, the first step of the operation is the same: a fold of the integuments is pinched up between the thumb and fore-finger of the left hand, and the blade of the instrument, previously oiled,—be it the seton-needle, or the bistoury,—is thrust through its base; if the seton-needle is used, it should be armed with the tape, or silk, and drawn through, its armature following, if the bistoury is employed, the probe is armed in

Fig. 126.



the same way, and passed along the base of the wound upon the blade (fig. 127). After the needle or the probe has thus

Fig. 127.



cleared the incision, it is disconnected from the seton, and the extremities of the latter are tied together, forming a loop which encloses a portion of the integuments; a poultice should be laid upon the wound, and retained in place by a proper bandage, for a few days, until suppuration has become established, when simple cerate may be substituted as a dressing, and confined by adhesive strips. The seton should be drawn daily backwards and forwards across the wound, in order to stimulate the latter slightly, and to sustain the discharge; and once or twice every week a clean seton should be introduced, by attaching one end of it to one of the extremities of the tape already in use, and drawing it within the wound.

Any part of the surface of the body may be selected for the establishment of a seton, — the blood-vessels and nerves being avoided, of course, — but the back of the neck, or the

upper part of the arm, is usually chosen as being the most convenient part.

Dr. Golding Bird has suggested and repeatedly practised a mode of inducing a continued purulent discharge from the surface, which is free from the objections generally entertained by patients against the methods in common use. It is an elegant adaptation of electricity to medical purposes.

He advises two small blisters to be applied to the surface at the desired part, one a few inches from the other; when the cuticle has become raised by serum, "snip it, and apply to the one from whence a permanent discharge is required a piece of *zinc-foil*, and to the other a piece of *silver;* connect them by a copper-wire, and cover them with a common water-dressing and oiled silk. If the zinc plate be raised in a few hours, the surface of the skin will look white, as if rubbed over with nitrate of silver. In forty-eight hours a decided eschar will appear, which (still keeping on the plates,) will begin to separate at the edges in four or five days. The plates may then be removed, and the surface where the silver was applied will be found to be completely healed. A common poultice may be placed upon the part to which the zinc was applied, and a healthy granulating sore, with well-defined edges, freely discharging pus, will be left."

Dr. Bird's explanation of this interesting phenomenon is, that the chloride of sodium contained in the fluid exuded beneath the cuticle is decomposed;—the chlorine being evolved at the zinc plate, forms with the metal a *chloride of zinc*, which is an escharotic.

This means will of course be applicable whenever, for any purpose, it is desired to destroy a surface, whether of the skin or of an ulcer. (London Medical Gazette, vol. iv., N. S. 1847, p. 981.)

ACUPUNCTURE.

For convenience-sake, the modes of practising acupuncture and vaccination will be considered in connexion with this chapter, although neither of these operations are performed with a view of effecting cutaneous irritation merely.

ACUPUNCTURE. — The instrument by which this is accomplished is a needle about two inches long, having a cylindrical shaft tapering towards one extremity to a sharp point; the other end is received into a small handle of ivory or of steel, or it is simply coated with sealing-wax. The needle is made sometimes of steel, sometimes of one of the precious metals. In introducing it, the instrument is held perpendicularly upon the surface, and forced through the skin to the requisite depth by a rotatory movement, combined with a sufficient pressure upon the point. The punctures are made in muscular, tendinous, or aponeurotic tissues, whichever may be the seat of suffering, and the depth of the puncture must of course depend upon the position of the tissue affected. It is advisable to allow the needle to remain in the part for a length of time, as for a half hour, an hour, or even longer, since a more permanently beneficial effect is thus produced than when the instrument is withdrawn at once. The needle may be extricated by making slight pressure upon the surface, and withdrawing the instrument with a rotatory movement.

No accident follows the operation, generally; rarely more than a drop of blood appears at the puncture; the chief vessels and nerves are always avoided, and the puncture should not penetrate any of the important cavities, or viscera.

Electro-puncture consists in passing through needles, introduced as above described, a current of electricity collected in a Leyden jar, or generated in a small voltaic pile, which is connected with the needles by a metallic wire passing to each pole of the battery.

Both these varieties of acupuncture are frequently of service in the treatment of neuralgia, and of rheumatism unattended with inflammation; in the treatment of indolent tumours also, by promoting their removal by absorption; in the cure of local paralysis, &c., &c. Simple acupuncture is very often resorted to in order to evacuate anasarcous collections.

Local pain of a violent neuralgic character may be relieved in many instances, and speedily, by rubbing upon the surface thus punctured a solution of sulphate of morphia, containing several grains in each ounce of water.

VACCINATION.

The operation, as generally practised, consists in inserting beneath the cuticle, at some convenient point, the matter of the cow-pock.

Several methods have been adopted for the collection and preservation of vaccine matter. If it were practicable, the simplest method would be, to transfer the liquid vaccine lymph from the arm of one child to that of another — upon whom the operation is about to be performed. But since this proceeding is not always convenient or possible, the virus must be collected and preserved in the liquid state, or in the form of the dry crust. In the liquid state, it may be preserved between two small plates of glass. Or capillary tubes, having a bulb at one extremity, may be placed in contact, at the open end, with the lymph of the fifth or sixth dry vesicle,— the air in the bulb having been rarefied by the warmth of the hand, or of the mouth, is again permitted to cool and contract, when the fluid will enter; so soon as a sufficient quantity has collected in the bulb, the extremity of the tube should be sealed in the flame of a spirit-lamp and blow-pipe. But the most convenient method to be pursued in the preservation of the virus is, to permit the lymph to dry, either on points of ivory, or as a scab upon the surface at the site of the vaccination. If the latter be adopted, the crust may be very well kept by being enveloped in tin-foil, or between two pieces of wax excavated to receive it. The author has recently vaccinated several children with a scab which has been thus preserved for two years; the vesicle was developed in each case, and passed through its customary phases with perfect regularity.

The operation may be performed with a thumb-lancet, or with a lancet made expressly for vaccinating; this differs from the thumb-lancet only in being smaller. The virus may be introduced beneath the cuticle, by means of lateral punctures made with the point of the lancet; or, the skin having been rendered tense between the thumb and fore-finger of the left hand, placed upon the part of the surface selected for the seat of the operation (generally the arm above the elbow),

the cuticle may be removed, over a minute space, by slight scratches with the point of the lancet, crossing and recrossing each other until the vascular surface is reached, (blood being just made to appear,) and then the virus be applied thereon. If the liquid lymph be used, it is simply requisite to moisten the lancet therewith, and to apply the blade upon the exposed surface; if the points of ivory be employed, one of them may be inserted beneath the cuticle, according to the first method of operating, or placed in contact with the denuded surface, if the second plan be adopted; if the scab be selected, a small particle of it should be reduced to powder and moistened with a little water, being rubbed to a pulpy consistence by the aid of the lancet-blade, which should now be wiped upon the abraded skin, so that a sufficient portion of the vaccine matter shall come in contact with the absorbing surface. After the operation is completed, the part should be left uncovered until the surface has become perfectly dry; the subsequent stages which the vaccine disease assumes, in the development and maturation of the vesicle, should be carefully watched, in order that a correct opinion may be had as to the efficacy of the operation.

CHAPTER IV.

ON THE METHODS OF ARRESTING HÆMORRHAGE.

THE occurrence of bleeding, as an accident, or in connexion with an operation, always claims the prompt attention of the surgeon, and often demands the manifestation of all his skill and self-possession.

In the consideration of this subject we shall describe the methods found most efficacious in arresting hæmorrhage, and state the circumstances to which each is most applicable.

1. By the action of cold. This is the simplest method of arresting the flow of blood from a wound, and its efficacy is exemplified daily, the mere evaporation which takes place at the surface of the wound reducing the temperature of the part, thereby favouring the coagulation of the blood and exercising a degree of constriction upon the bleeding vessels. This effect may be increased by exposing the divided tissues to a current of air, naturally or artificially excited. Bleeding from superficial wounds, or abrasions, when no vessel of notable size is opened, may generally be checked by this simple mode.

The application of cold water, or of ice, to the bleeding surface, or to its immediate vicinity, is still more effectual, and will very often arrest hæmorrhage from small arteries. Dr. G. N. Burwell, of Buffalo, informed the author very recently, that he had succeded in stopping profuse bleeding from a deep transverse wound of the palm of the hand, by the constant application of ice during twenty-four or thirty-six hours. The ice may be placed in direct contact with the wound, or it may be enclosed in linen, or in a bladder. If cold water is used, it may be simply laid upon the surface in saturated lint, or it may be employed by douche, or irrigation; the latter is the most efficacious. Evaporating lotions may be found effectual sometimes, in the absence of ice.

2. By the application of astringents, and styptics. These act, probably, in a twofold manner,—upon the organic proper-

ties of the bleeding vessels and surrounding tissues, and also upon the blood itself; causing by the former, a constriction, a greater or less degree of closure, of the vessels,—and by the latter, favouring coagulation of the effused blood which mechanically prevents the escape of more. There are many substances which induce coagulation of blood, not by any chemical, or vital, agency which they exert, or develope, but simply by opposing the flow at numerous points, so that it becomes retarded, and then coagulates by its own inherent properties; such are cob-web, filaments of lint, powdered sugar, and other similar domestic remedies.

The astringent and styptic applications which have been found most serviceable for the purpose under consideration are, powdered alum; powdered galls; sulphate of copper and of zinc, also in powder; creasote, and the tincture of the muriate of iron. Fluids act most rapidly because they come most speedily in contact with the points from which the blood escapes; they are applied usually by means of a brush of camel's hair, or upon a feather, passed over the surface; or by saturating with them a piece of lint which is pressed lightly upon the part. If a powder is used, it may be sprinkled over the surface, or retained upon it by gentle pressure. The tincture of the muriate of iron is probably the best of these means. These agents will generally suffice to arrest bleeding from vascular surfaces, no large vessel being opened,—for example, in hæmorrhage from the mucous membrane lining the nostrils, in bleeding ulcers on the neck of the uterus, in bleeding hæmorrhoidal tumours.

Matico, a plant growing in South America, has been lately recommended as possessed of particular efficacy in arresting hæmorrhage. Dr. Ruschenberger, of the U. S. Navy, has employed it in a large number of cases, and bears strong testimony to its value as a hæmostatic agent. He used it successfully to arrest bleeding from a bubo which had been opened by the knife, and from which the blood issued in full and free jets, long-continued and well-applied pressure having failed to arrest it; it likewise caused the cessation of bleeding from hæmorrhoids removed by incision, which had produced troublesome hæmorrhage, resisting other applications of various kinds. The mode which Dr. Ruschenberger advises for its employment is, to break the dried leaves into a coarse powder and to

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form with this, by the aid of water, a pultaceous mass, which should then be placed upon the bleeding surface and retained there by very light pressure,—a pressure which would not prove sufficient, of itself, to arrest the bleeding. Dr. R. speaks highly of the efficacy of matico, taken in infusion, for spontaneous hæmorrhage, having proved its value in profuse menorrhagia, in hæmophthisis, and similar cases.

3. By cauterization. This produces an eschar, sealing up the orifice, or orifices, from which the blood escapes. So long as the eschar remains adherent to the vessel, it presents a mechanical impediment to the further escape of blood; but when, in the process of nature, the slough has become detached, the hæmorrhage will recur, unless the vessel has become permanently obliterated from its open extremity as high up as the first branch above it; hence the patient should be carefully watched about the time at which the slough seems inclined to separate, lest the bleeding should return unexpectedly. In the choice of a cauterizing agent, therefore, some one must be selected which shall produce an eschar sufficiently deep to remain adherent, until nature shall have accomplished the permanent closure of the vessel between the points mentioned. The fact should be borne in mind that, the application of any caustic will prevent the possibility of union of the wound by the first intention. The actual, or the potential cautery, may be used.

In employing the actual cautery, the metal, generally iron, should be heated to whiteness and then applied upon the surface for a few seconds only; both of these precautions are necessary, for if the iron be of a lower temperature than that which constitutes 'white heat,' the eschar occasioned by it is less perfect and its action is more painful; and if the cautery be kept too long in contact with the tissues, it adheres to them, and when it is withdrawn, it removes the eschar with it, thereby destroying, of itself, the good which it had accomplished.

The form of the cautery should be adapted to the character of the part to which it is to be applied: thus, if the wound be narrow, and the bleeding vessel lay at the bottom of it, the iron should be sufficiently long and small to reach to the orifice of the vessel. The annexed drawing illustrates some of the most common forms of the actual cautery. (Fig. 128.)

Fig. 128.



The actual cautery is now rarely used to arrest hæmorrhage, this object being almost always effected by some other means more simple, and less shocking in appearance. The cases in which it is still recommended are, in operations upon the bones of which the medullary membrane is excessively vascular; in the bleeding which sometimes follows the extraction of a tooth, and in others similar.

Of *the potential cauteries*, those most used are, the nitrate of silver, and concentrated sulphuric acid. The former may be employed in the solid state, its extremity having been previously more or less pointed, by friction upon the surface of a wet rag, or in concentrated solution, as of ℈j to a fluid-ounce of water, applied, as is the acid, by means of a brush. The efficacy of lunar-caustic, in stick, in arresting bleeding from leech-bites, has already been mentioned. The solution of the salt, or the sulphuric acid, is often of service in hæmorrhage from incised or ulcerated surfaces, which are too much removed from sight to admit of nice inspection and handling, and from those which present no apparent vessel, or bleeding point: thus bleeding ulcers or wounds on the neck of the uterus are sometimes treated, a speculum vaginæ being used to assist the surgeon in the application of the remedy.

4. By directly obliterating the vessel which gives out the blood. This may be a temporary or a permanent effect, as the means used are temporary or permanent in their action. Transient obliteration may be best induced by simple pressure upon the vessel; permanent occlusion is produced by torsion, and the use of the ligature. The former is applicable to all

varieties of accidental bleeding, whether it be arterial, venous, or capillary; the ligature and torsion are employed almost exclusively in arterial hæmorrhage.

PRESSURE.—The mode of making the requisite compression varies according to circumstances.

If there be a wound bleeding moderately, or if the blood be of a venous character, it very often happens that the hæmorrhage is arrested by the mere apposition of the edges of the wound, if it be an incised wound; or by the simple pressure upon it of the dressings, if it be such as not to admit of apposition of its lips. When the divided vessels are of a larger calibre and bleed more freely, pressure should be made with the aid of a compress and adhesive plaster, or a roller (as in fig. 125). Direct pressure upon a wound is objectionable, particularly if it be a lacerated or contused wound, or if much pressure be required to produce the desired effect, because it will interfere with the reparation of the injury, and may induce sloughing. When positive pressure is to be exerted for the sake of the compression, the vicinity of the wound should therefore be selected as the site of its application, rather than the wound itself.

Pressure is employed also to prevent hæmorrhage during operations, as in amputations, and likewise in accidental wounds, as a temporary expedient, until some more permanent measure be adopted. For this purpose, the compressive force may be applied at any point at which it can be most effectually and conveniently exercised. The simplest method of instituting this measure, is to press the fingers upon the course of the vessel through which the circulation is to be arrested. With this object, some point should be selected where the vessel is readily felt pulsating; and, if possible, this point should be favourably situated with regard to some bony support, so that the vessel can be pressed against the latter, and thus be completely obliterated. For example, the facial artery should be compressed against the edge of the lower jaw, at the anterior margin of the masseter muscle; the temporal and occipital arteries, at any point of their course, at which they can be felt; the brachial artery, by grasping the biceps muscle, at the middle of the arm, between the fingers and thumb of the right hand, and at the same time pressing the artery against the bone with the points of

the fingers, on the inner side of the muscle, (fig. 129;) the axillary artery, by thrusting the fingers,—their points approximated,—into the axilla, and forcing the artery against the

Fig. 129.



Fig. 130.



head of the humerus; the subclavian artery, by pressing the thumb down upon the vessel, behind the clavicle, upon the point at which the artery crosses the first rib on the external side of its tubercle; generally, the artery cannot be sufficiently well compressed by the thumb, and it is necessary, therefore, to employ some instrument for the purpose, as a common door-key, of which the ring should be wrapped with a piece of linen, and then pressed upon the vessel, as above advised; the femoral artery, by placing one thumb upon the vessel, at the point where it crosses the ilium to descend the thigh, and making the requisite pressure by the other thumb acting upon the first, (fig. 130;) the abdominal artery, by causing the patient to occupy a position whereby his back and thighs shall be flexed, and the abdominal parietes relaxed, and then pressing the artery against the spinal column.

But, although it is not necessary in most cases, to exert much force with the fingers, the muscles are very soon fatigued, so that the pressure becomes unsteady and uncertain, if it be maintained for any length of time; and moreover, the fingers are liable to become displaced by any sudden movement of the patient; hence the necessity of employing some compressing force which shall not be liable to these objections. The tourniquet offers such advantages.

The *tourniquet*, in its most common form, is very well represented in the annexed drawing, (fig. 131.) It is so contrived, that when the strap is buckled around the limb, by

FIG. 131.



turning the screw the soft parts are compressed and the pad forced upon the artery. Before applying the tourniquet, the surgeon should examine it carefully, to see that it is in good order,—the screw, strap and buckle strong,—so that it shall not fail when most needed. A firm pad should be made, of a cylindrical shape, for application over the artery, and the strap secured around the limb. The screw should not be turned too rapidly, and no more compression should be exercised about the limb than may be necessary to prevent the

flow of blood below the point of pressure. A long-sustained application of this instrument is productive of considerable pain, and therefore it should be avoided.

The points upon which the tourniquet is applied to the limbs are not fixed. Mr. Fergusson recommends those indicated in the accompanying drawings (figs. 132, 133, 134),

FIG. 132.



FIG. 133.



FIG. 134.



preferring compression of the artery in the popliteal region, when the leg is to be amputated below the knee, rather than of the femoral artery at the upper part of the thigh.

An 'impromptu' tourniquet, for use in emergencies, consists of a cravat, in the middle of which a knot is formed; the cravat is made to encircle the limb, the knot corresponding in situation with the artery: the two extremities are then tied together, a piece of stick inserted between them and made to revolve until the limb is sufficiently compressed. This is commonly called the field-tourniquet. (Fig. 135.)

Fig. 135.



Fig. 136.



An objection to the ordinary tourniquet is, that it constricts the whole limb, preventing the circulation through the veins as well as through the arteries, causing considerable pain and swelling, if continued beyond a short time. To obviate this difficulty, compressing instruments of various kinds have been invented: they have not, as yet, arrived at such perfection as to be, on the whole, preferable to the tourniquet in common use. The compressor of Dupuytren "consists of

two steel-plates (fig. 136), half an inch broad, curved and joined at the centre of the instrument in such a manner as to allow of the curve being increased or diminished at will. To these plates two others, which support pads, are attached: one of the pads is movable, the other fixed; and in applying the instrument, the movable one is placed over the artery, the other rests upon the opposite side of the limb. The pressure is made by the movable pad, and is regulated by a screw." (Liston's and Mütter's Lectures on Surgery, p. 42.)

Dr. Dorsey (Elements of Surgery, vol. i., p. 57) mentions a very simple and ingenious expedient by which the same effect was attained. "The patient was a child, in whom several unavailing attempts had been made to tie up the divided vessel (an artery in the foot), and the wound was in a state of great inflammation. A compress was applied over the trunk of the anterior tibial, and another over that of the posterior tibial artery, about two inches above the ankle; over these a strip of sheet copper was passed around the leg, and a tourniquet applied over the copper: when the tourniquet was tightened, the tibial arteries were compressed and the bleeding ceased, the copper preventing the tourniquet from compressing any other vessel, so that the circulation in the foot was not interrupted. In a few days the wound healed without any recurrence of hæmorrhage."

Since the treatment of aneurism by compression has become a standard measure, great improvements have been made in the construction of tourniquets, and the great desideratum seems to have been, to a considerable extent, gained, viz.: to exercise a moderate, but sufficient compressive force upon the artery, without interfering materially with the return of the blood through the veins. The fact has become established, that, to cure an aneurism, it is not essential absolutely to prevent the arterial circulation, but merely to reduce it to a certain sluggish current. Several instruments have been contrived which produce this effect; and they can, moreover, so completely obliterate the artery, as to be adapted for use in amputations, or in other cases where it is necessary that the arterial flow should be stopped, for the time. The Dublin Surgeons, particularly Drs. Bellingham, Carte and Tafnell, deserve most of the credit for these improvements.

Fig. 137 represents an instrument of this kind, designed

for application to the middle of the thigh; and fig. 138, one for the groin.

Fig. 137



Fig. 138.



If employed simply for the purpose of arresting or preventing hæmorrhage, only one tourniquet or compressor will be required. But if applied for the cure of aneurism, it is considered better to use two, so that when the pressure caused by one becomes disagreeable, the other can be brought into service immediately.

Dr. Carte's compressor, as represented in fig. 139, possesses

FIG. 139.



this peculiar feature, that, in addition to the common screw force, a certain degree of elasticity is gained by the introduction of bands of vulcanized India-rubber.

PLUGGING of the divided vessel, or of a wound, is sometimes resorted to for arresting the flow of blood when other means have failed. It acts by compressing the vessel, or by mechanically stopping its orifice. It is rarely done now, excepting occasionally when blood continues obstinately to flow from the cut extremity of the bones in amputation: here a piece of lint, or of wood, having a ligature attached to it, is gently pressed within the cavity of the bone, or within its reticulated structure, and allowed to remain, the ligature hanging from between the edges of the flap, so that the plug may be removed when it has fulfilled its intention.

TORSION is now but little resorted to. It consists in twisting the vessel several times upon its axis, so as to rupture its inner and middle coats, which then become more or less inverted, as when cut by a ligature. Many methods of performing this simple operation have been advised, of which the simplest is probably as effectual as any. The artery should be seized at its open extremity by a pair of serrated forceps (fig. 140), with which it is drawn out from the wound, and

FIG. 140.



isolated from its connexions with the surrounding tissues; it is then held in the grasp of a pair of catch-forceps placed across its axis, at the distance of half an inch from its open end, and twisted several times in the direction of its axis by means of the first forceps (fig. 141): the torsion having been

FIG. 141.



thus accomplished, the vessel is returned into the wound. This is not generally trusted to as a safe and certain means of arresting hæmorrhage, excepting in the instance of small arteries. If the vessel can be thus seized and twisted, a ligature can certainly be applied to it as well, and will scarcely give rise to more irritation than the portion of the artery thus violently crushed and reduced to the condition of a foreign body in the wound.

The LIGATURE offers the most safe and permanent means

of obliterating an artery of a size sufficient to admit of its application.

The object had in view in the employment of the ligature is, the division of the internal and middle coats of the artery; these retract within the canal, giving the latter the appearance of a cone, of which the apex points towards the ligature. The cavity of the vessel, from the ligature to the first branch above it, becomes filled with a coagulum of blood, and the same coagulating process takes place in the blood which has been effused outside of the vessel; soon, however, a permanent obliteration occurs, from a vital process, some degree of inflammation and exudation of plastic matter being occasioned by the irritation of the ligature, and a complete consolidation of the tube ensuing from union of the internal tunic of the artery with the organizable mass within it.

Many substances have been recommended as materials for the ligature. It has been supposed that leaden ligatures excite less irritation in the midst of the tissues than those of any other material; ligatures made of animal fibre, as of the sinew of the deer, have been supposed to be removed by absorption at the point at which they are tied; but these are probably mistaken ideas; no one now thinks it advisable to incur the trouble of preparing ligatures of such materials, for the sake of any advantage which fancy may attribute to them over the ordinary ligature, made of saddler's silk, or of common flaxen thread.

A single strand of strong saddler's silk, or of good home spun thread, will answer for application to small arteries but when the vessel is larger, the ligature should be correspondingly more thick, as of from two to four strands. These

Fig. 142.



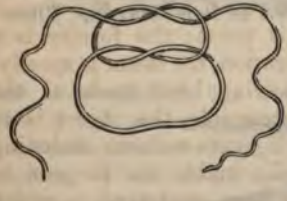
should be well waxed, and twisted firmly and roundly, in order to cut the coats of the artery, as before mentioned, a flattened ligature not effecting this object. Hence also in

applying the ligature, the knot must be drawn tightly. For the purpose of seizing the artery, in order to isolate and tie it, the forceps figured on p. 295 (see fig. 142), having a toothed extremity and a spring-catch to keep this closed, is a very convenient instrument, less so, however, than the *tenaculum* (fig. 143) — a hook with a long curve sharp at the point — which is inserted into the mouth of the vessel, and by which the latter is drawn out. The artery being thus brought within reach, it should be separated from its connexions with the surrounding tissues, vessels, and nerves, for the space of a few lines, and the ligature applied around it, behind the tenaculum, or forceps. It is sometimes proper to include a portion of the surrounding tissues in the knot, as when the coats of the artery are supposed to be weakened from inflammation or other cause, or when the mouth of the vessel which bleeds cannot itself be seen, and yet the surgeon is assured that it is within the mass which he has raised upon his tenaculum, or by his forceps. If an artery of considerable size has been divided, it is advisable to tie both extremities, as otherwise the bleeding may be renewed from that portion of the vessel which was not at first emitting blood, but into which an anastomosing current has afterwards discharged itself: this precaution is particularly necessary in situations where the anastomosis of arteries is known to be common, as in the palm of the hand and on the foot.

Fig. 143.



Fig. 144.



"The sailor's knot," as it is called, is the one best calculated to secure the artery firmly; it forms, when tightly drawn, a flat knot which will not slip. The accompanying drawing illustrates it better than a verbal description. (Fig. 144.)

The vessel having been tied, one division of the ligature should be cut off close to the knot, while the other is left hanging from the wound. When many vessels have been

tied, the ligatures thus cut should be grouped together and allowed to project at one extremity of the wound, of which the edges should then be approximated: when one of the vessels tied is of large size, as the main artery of a limb, the ligature which is attached to it should be indicated by a knot made at its free extremity.

The length of time during which the ligature remains connected with the artery, varies according to the size of the latter; generally, from five to twenty days may be considered as elapsing before the external coat of the vessel becomes severed at its point of constriction; then the ligature is loosened and falls from the wound, or may be readily drawn from it. After the usual time has passed, the ligature may be gently twisted and drawn upon, in order to favour its release, as sometimes it is retained by the granulations in which it is imbedded, after its attachment to the vessel has ceased. The ligature appertaining to the largest vessel should be handled more carefully than the others. The patient should be carefully watched about the period at which the ligatures become detached, particularly when large vessels have been tied, lest an unexpected hæmorrhage occur. Secondary bleeding requires the same treatment as the primary.

The forceps and tenaculum are the only instruments required for tying a vessel which presents itself at the surface of a wound. But it often happens that the bleeding artery cannot be seen, it having retreated within the substance of the tissues: it then becomes necessary either to slit open the tissues from the point at which the hæmorrhage appears, or to cut down upon the course of the vessel above the wound, and pass a ligature around it at this point; the former is a very uncertain and disagreeable operation, the latter is speedy, simple, and sure. The incision having been made at the point at which the vessel is most accessible, the object is to inclose the latter in the loop of a ligature without including the accompanying vein or nerve. To enable the surgeon to effect this, several instruments have been contrived, to which the term *aneurism-needles* has been applied. The simplest, and one which answers very well almost always, is shown in the following drawing (fig. 145); it needs no farther description. When the sheath of the vessels has been opened, the

extremity of this needle, armed with a ligature, is carried under the artery and brought out on the opposite side, when one division of the ligature is seized between the fingers, or

Fig. 145.



by a forceps, and drawn out upon one side, while the other portion follows the needle as it is removed at the other side of the wound: the vessel is then tied, as above advised. Professor Gibson has invented an admirable instrument for passing a ligature beneath deep-seated arteries. It consists of a flattened canula of silver sufficiently strong, curved rather more than the common aneurism-needle figured above, and fitted to a handle; through the interior of the needle, of which one extremity of the cavity opens near the handle on the back of the needle, and the other at the point, a piece of watch-spring passes, having an eye at the extremity nearest the handle, and terminating at the other end in a head of silver; the ligature is placed in the eye of the spring, and the needle is passed beneath the artery; then the spring, which is considerably longer than the needle, is pushed through the cavity of the instrument and appears upon the opposite side of the vessel, carrying the ligature with it. Belloc's instrument, illustrated by fig. 148, would answer very well in many cases where the artery is deeply located. But in the majority of instances, a ligature can be readily passed around a vessel by means of the grooved director and the eyed-probe, which are in every one's pocket-case. The director is introduced beneath the vessel, and carried completely across the wound, so as to rest upon the edges of the latter, the artery being raised upon it; then the probe, armed with the ligature, is slid along the groove of the director, beneath the artery, and drawn out upon the opposite side with the ligature. In some instances, the bleeding artery is

concealed behind a projecting bone, as, for example, the internal pudic behind the rami of the ischium and pubis; in order to secure this vessel, Dr. Physick's forceps, having a curved needle inserted between its blades, and furnished with a hook to compress its handles, will be found the most convenient instrument. (Fig. 146.)

Fig. 146.



The surgeon is sometimes called upon to arrest hæmorrhage from one of the natural canals, or cavities, particularly from the nostrils and rectum.

Epistaxis occurring in individuals of a hæmorrhagic diathesis, frequently induces a dangerous degree of prostration. If it resists the use of cold water, or ice, applied upon the face and forehead, or on the back of the neck, and if astringent powders blown into the nostrils, or injections of astringent solutions, fail to arrest it, the nostrils must be plugged. Stopping the anterior orifices of these cavities will not suffice, as the blood will continue to escape through the posterior nares; both must be stopped therefore. To effect this, a piece of thin wire may be doubled upon itself, and the folded end introduced along the floor of the nostril, from before backwards, until it has traversed the passage and appears at the back part of the mouth; the surgeon then seizes this looped extremity with his fingers, or forceps, introduced into the mouth, draws it forwards, — the body of the wire still resting on the floor of the nostril,—and passes a cord through it, the centre of the cord corresponding with that of the loop, while the ends are loose; the wire is now drawn out of the nose in the direction by which it was introduced, one of the divisions of the ligature emerging with it, the other remaining in the surgeon's hand; to the middle of this portion of the cord a piece of lint is attached, to serve as the plug, which is drawn into the posterior nares by the first division of the ligature; the anterior nares are next to be plugged, by inserting lint, and the hæmorrhage is thus effectually

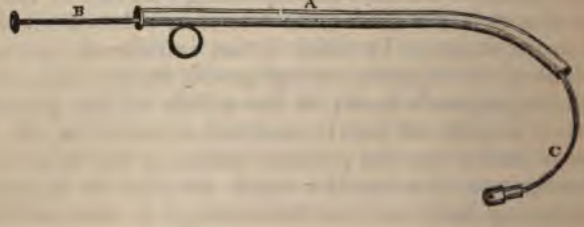
Fig. 147.



arrested. At the end of two or three days, the plugs may be removed, the posterior being drawn out by means of the extremity of the cord which has been left hanging from the mouth. (Fig. 147.) See Liston and Mütter, p. 185.

A very elegant and useful instrument for plugging the posterior nares has been invented by M. Belloc. It is a canula of silver, A, curved very much like a catheter, but smaller. Through this canal a straight stem of silver, B, is introduced, to which is attached a piece of watch-spring, C, terminating in a rounded head which has a hole drilled in it for the insertion of a ligature. The free extremity of the straight rod, B, has a button attached to it, to prevent it from being drawn out of the canal; a ring is soldered to the inferior surface of the canula, to aid in holding the instrument. (Fig. 148.) In introducing this, draw the watch-spring entirely

Fig. 148.



within the tube so that the head shall form a smooth convex extremity to the instrument; then the tube is passed along the floor of the nostril, the curve presenting downwards, until its head reaches the extremity of the naso-palatine septum, when the watch-spring is pushed out, its curved form causing it to find its way directly into the mouth; the head is now drawn forwards, and a ligature, with a plug of lint attached, is passed through the eye; the remainder of the operation is managed precisely as with the wire above spoken of.

In HÆMORRHAGE from the RECTUM, if the bleeding vessel cannot be tied, or if the blood comes from the venous plexus, astringent powders should be introduced; if these fail, a piece of bladder, or a portion of the intestine of some animal, filled with pounded ice, should be inserted within the sphincter ani as high up as may be necessary. But the presence of these foreign matters, as well as of the effused blood, after a time excites the expulsive efforts of the muscles and they are discharged. In a case of this kind which occurred some years ago at the Pennsylvania Hospital, during the attendance of Dr. Thomas Harris, lately chief of the Naval Bureau of Medicine at Washington, all these and other methods of arresting the bleeding failed; it was stopped by pressure upon the bleeding point, effected by means of a finger introduced into the rectum and held there for many hours, so long as any disposition to recurrence of bleeding was manifested; — so soon as one individual became fatigued he was relieved by another.

CHAPTER V.

ON THE DRESSING OF WOUNDS.

THE exposure of the wound for inspection constitutes the first step in its treatment. This should be accomplished very carefully, after the manner recommended to be pursued with regard to the examination of fractures. The arrest of hæmorrhage should next engage attention; this will be effected by some of the means already adverted to. It should be borne in mind that, if it be probable that the wound may be made to close by direct union of its edges, this will be prevented by the application of styptics or escharotics to check the bleeding, and therefore if the simple pressure produced by the apposition of the edges of the wound, and the means used to secure this, be not sufficient to stop the flow of blood, the ligature should be applied to such arteries as bleed. In a simple incised wound, all the vessels of sufficient size to require a ligature are seen pouring out blood; but in wounds accompanied by severe contusions and lacerations, such as are caused by the bursting of fire-arms, or by machinery; it is not at all uncommon to see the arteries of the largest calibre projecting an inch or more from the midst of the torn muscles, and vibrating with every beat of the heart, yet not emitting a drop of blood; in such cases, ligatures should still be applied to these arteries, and at a point where their coats seem to be uninjured; otherwise, after the wound has been dressed, and the vitality of the injured parts has become restored by warmth and rest, profuse bleeding will occur and render it necessary to reopen the wound. It is neither important nor advisable to tie very small arteries, as a short exposure to the air and moderate pressure will generally prevent these from bleeding, and an unnecessary number of ligatures will interfere very much with the healing of the wound.

All foreign substances, such as dirt, sand and gravel, splin-

ters of wood, fragments of clothes, shot, &c., should be carefully removed from the wound by the aid of forceps, or with the fingers, or by allowing a stream of warm water to flow gently over it. Coagulated blood should not be permitted to remain upon the injured surface, but should be regarded as a foreign body, as much as any of the substances enumerated. These preliminary measures having been attended to, the proper mode of dressing the wound must be determined upon; and in the selection of the pieces of the dressing, it should be borne in mind that lightness and cleanliness are of great importance in inducing a rapid cure.

If the wound must heal by granulations, the surgeon should not attempt to confine its edges in apposition, as a considerable degree of compression must be exercised to effect this, causing pain without any adequate good. He should be contented with simply placing the limb, or other part, in the most favorable position to ensure ease and rest, and cover the wound with a suitable dressing,—cold water or a poultice, generally, at first, to allay pain and to combat inflammation, followed, when these symptoms have subsided, by the application of an appropriate cerate, or lotion; these dressings should be retained upon the surface by strips of adhesive plaster, or by a light bandage. In severe contused and lacerated wounds, the best primary application is cold water, in the form of irrigation. (See Part I.)

When the wound is of such a character as to afford fair reason to expect reparation by the first intention, its surfaces should be placed in apposition along their whole extent, from the bottom to the top, and not along its edges merely; otherwise, though the latter may adhere to each other, granulations will form beneath the external lips, or summit of the wound, and a collection of matter be the result, which will eventually burst through the adhesion formed above it, and then the surface will necessarily be disfigured by a cicatrix which might have been avoided. The proper apposition of the walls of the wound may be secured by the use of adhesive plaster, by suture, and by suitable bandages,—by one or all of these means. Before resorting to any of these, however, the part, particularly if the wound be deep, should be placed in such a position as shall most relax the muscles involved: thus, for example, if there be an incised wound cutting across the muscles

on the front of the thigh, the limb should be raised upon an inclined plane, and the back elevated in like manner; without this simple precaution, the sides of the wound can be but imperfectly retained in apposition by any compressive means.

1. The mode of applying strips of the common adhesive plaster, and of isinglass plaster, has been already described (see Part I.): aided by a proper position of the injured part, the strips will be found adequate to secure the adhesion of most wounds. When the extent of surface upon which the strips can be applied is not sufficiently great to ensure firm support, their power may be much increased by placing a narrow strip of plaster near to, and parallel with, each edge of the wound, and crossing the main strips upon them. Again, if the strips are subjected to much strain, it will be found of importance to make moderate pressure upon the muscles by means of a roller, or bandage of Scultetus. In removing this dressing, the precautions advised in the first part of this volume should be attended to.

From his own experience, the author ventures to think that the reports with regard to the irritation caused by the ordinary adhesive plaster of good quality, and the liability of erysipelas being occasioned by it, are very much exaggerated.

Recently it has been ascertained that "*collodion*," a solution in ether of the "gun-cotton," as commonly prepared, is possessed of very strong adhesive properties; it may be spread upon linen or silk, and then applied to the surface; and it offers this advantage over other adhesive matter, viz.: that, being insoluble in water, the parts surrounding the wound may be washed without disturbing the wound itself, by removing the plaster which covers it. To separate the plaster from the surface, it is necessary to moisten the application with ether. (See p. 38.)

Gun-cotton is made by saturating carded cotton in a mixture of equal parts of strong nitric and sulphuric acids, then washing the cotton in water, and drying it at a temperature of 150°, or less.

2. Several kinds of suture have been invented for the purpose of securing perfect apposition of the surfaces of incised wounds. They are passed directly through the skin at the edges of the wound, or through strips of adhesive plaster pre-

viously applied near to its margins: to the former, the term "wet suture" has been given, the latter is called "the dry suture." Of the first there are four varieties in common use: the interrupted, the continued, the quilled, and the twisted suture.

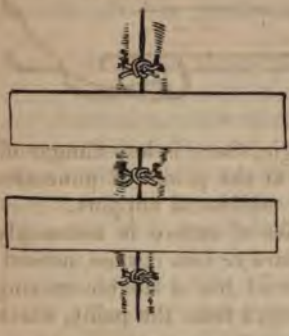
The *interrupted suture* is made, by passing a needle armed with a single strand of saddlers' silk, or of some other equally strong material, through the skin from without inwards, entering at the distance of two or three lines from the edge of wound, crossing the latter, and re-entering the skin at the opposite margin of the wound, to re-appear a few lines from the edge: the two portions of the thread are then tied together in the sailors' knot, as shown in fig. 144. The number of sutures thus made varies with the length of the wound and the strain which must fall upon each knot; generally, their number should not be greater than may be necessary to retain the lips of the wound in close apposition. In order to diminish the number of sutures, by supporting each one, strips of adhesive plaster may be laid across the wound, between each two sutures, leaving space enough between the latter and the edges of the plaster, to allow of the escape of fluids from beneath. Additional aid is sometimes given to the stitch by a roller, or a bandage of Scultetus, passed around the wounded part; but this should be avoided whenever it is practicable to do so, as the dressing is thereby rendered less light and cool.

In most cases, the surfaces of the wound will have become sufficiently adherent, after the lapse of forty-eight hours, to admit of the withdrawal of the sutures; this may be effected by passing the sharp point of a pair of narrow-bladed scissors beneath the thread and cutting it, after which it may be gently drawn out. If allowed to remain longer than two or three days in the skin, the suture excites inflammation and slight ulceration around itself, thereby deforming the appearance of the cicatrix. The strips of adhesive plaster and, if necessary, the bandage also, should be retained, in order to give security to the recently formed adhesions, after the removal of the suture. The following drawing illustrates the application of the interrupted suture. (Fig. 149.)

The *continued suture* is less used than the last. It is the one employed in wounds of the intestines, and also in closing

the incisions made in conducting post-mortem examinations.

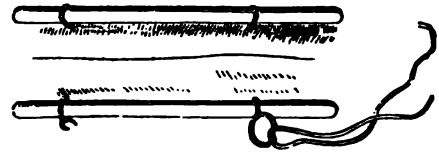
Fig. 149.



It is the stitch commonly used in sewing, and is otherwise called the *glover's stitch.* The needle is first entered as in making the interrupted suture; it then crosses the wound obliquely from the opposite side to the margin first penetrated, and is again inserted at a point below the first, thus crossing and recrossing the wound obliquely until a sufficient number of stitches have been laid, when the ends of the thread are secured, at each extremity of the wound, by being tied around the first and last stitch respectively. The distance between the stitches must depend upon the length of the wound and the resistance which they are expected to overcome; they may be aided in their retentive action by the application of a roller, or a bandage of Scultetus.

The *quilled suture* is now but little used: Mr. Liston says of it, "it is only employed in one operation — that for lacerated perinæum. I have used it two or three times in cases of this kind." It is effected by entering the needle, armed as before, at about four lines from the edge of the wound, and carrying it downwards to reappear at the bottom of the wound; then ascending just exterior to the opposite lip, it emerges at about four lines from the edge, opposite the point at which it first entered; if the wound be very deep, it will be more convenient to carry the needle from above downwards, on both sides, rather than from the bottom of the wound towards the surface. A portion of the thread should be left extending from each side of the incision, and when a sufficient number of stitches have been introduced to support the wound, a piece of a gum-elastic bougie, or a quill, of the same length as the latter, is placed parallel with the incision on each side, between each two strands, which are then tied upon the tube with force sufficient to retain the entire surfaces of the wound in apposition, after they have been approximated by the hands. (Fig. 150.)

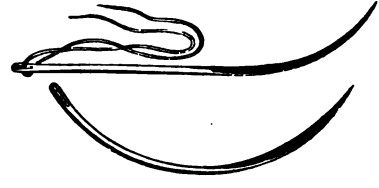
Fig. 150.



The advantages of this suture are, that it forces the sides of the wound together throughout its entire depth, instead of the edges merely, and that, by the intervention of the quills, or pieces of bougie, there is less danger of the skin being torn by the threads at the points of puncture. A bandage may be employed as an additional support.

The needle used in these varieties of suture is commonly called the *surgeon's needle:* it is more or less curved, according to the fancy of the operator, and has a double cutting edge extending about half of its length from the point, which should be very sharp; the eye should be large. The accompanying drawing represents two forms of the surgeon's needle, of which the straightest will generally be found to be the most convenient (fig. 151): the size should correspond with the thickness of the thread to be used, and the part or character of the wound, for which it is to be employed.

Fig. 151.



The *twisted suture* is chiefly used to promote adhesion between the edges of incised wounds upon the face, especially after the operation for the relief of hare-lip. A well-silvered pin, very sharp at the point, is passed, with a rotatory motion, through the skin, at a point two or three lines distant from the edge of the incision, and brought out on the opposite side, at the same distance, the extremities of the pin extending beyond the incision; then the centre of a single strand of thread or silk, is thrown over one end of the pin, and crossing the wound—of which the lips are now in contact,—is turned around the other extremity of the pin, in the form of the figure 8; thus the threads cross and recross until several turns are made. Generally, two pins are introduced, sometimes

Fig. 152.



more, and thread twisted upon each, as above. (Fig. 152.) When the suture is thus made, the extremities of the pins are cut off by means of a pair of small cutting-pliers. The pins themselves should be carefully drawn out at the expiration of two, or at most, three days, otherwise ulceration will be excited around them, and an unpleasant scar will be the result; the threads should not be disturbed for some days longer. When used in an operation upon the upper lip, the invaginated bandage, shown in fig. 25, will be found a convenient support, if any should be needed.

Fig. 153.



Mr. Fergusson is in the habit of employing the instrument represented in fig. 153, for this purpose. It consists of a semi-circular spring, padded at both extremities, which passes around the base of the cranium, so that the pads cause the margins of the wound to approximate, and thus remove any strain from the sutures. The instrument is held in position by straps.

A particular kind of needle or pin, made of silver, with a steel point which may be detached, has been contrived for this suture, but the common pin of good quality answers just as well, and is much more convenient.

The *dry suture*, as before hinted, is made by surrounding the part—a limb generally—with a strip of adhesive plaster placed close to each margin of the wound, and passing from one to the other as many stitches of the interrupted suture as may be required to retain the edges in apposition.

M. Baudens, chief surgeon to the "Val de Grace" hospital,

recommends the following kind of dry suture, to approximate the edges of the flap after amputation; he surrounds the limb, above its cut extremity, with a circular bandage, through which he passes pins in front and behind, leaving the extremities of the pins projecting; then, while the flaps are brought together accurately by an assistant, the surgeon passes from one pin to the opposite, pieces of thread, wrapping them around the pins with sufficient tightness to retain the flaps in apposition.

M. Vidal (de Cassis) has invented an ingenious little contrivance for retaining the margins of incised wounds in apposition. He calls it the "*Serre-fine*," and the Institute of France awarded him a prize for it. It is made of fine silver-wire, twisted so as to bear a remote resemblance, in shape and size, to the "*eye*" which ladies use in hooking their dresses; the end of each leg is bent at a right-angle, and is toothed, so as to be capable of piercing and remaining fixed in the skin; and the spring is so arranged that when the "serre-fine" is left to itself, after having been properly set in the margins of the incision, it approximates these.

M. Vidal has described and represented this little invention in the last edition of his "*Traité de Pathologie Externe.*"

We think it rather ingenious and pretty, than useful.

The *bandages* used to promote union of incised wounds are the common roller, the bandage of Scultetus, and the invaginated bandage. The first two are employed to give support merely to adhesive strips and sutures. The invaginated bandage acts directly by approximating the edges of the incision; its composition and mode of application vary, as the wound is longitudinal or transverse. These bandages are applied to the extremities generally.

The invaginated bandage for longitudinal wounds is thus prepared: A linen roller is taken, of a width corresponding with the length of the wound, and sufficiently long to make several turns around the limb: at the free extremity of this roller several slits are made, each about an inch broad and six or eight inches long; and beyond these, at the distance of a few inches, fenestræ are cut, in number corresponding with the slits, (fig. 154.) Thus prepared, the centre of the undivided portion of the bandage is placed directly opposite the wound, by the margins of which graduated compresses

(*a*, *a*, fig. 155) have been arranged, one on each side: the slits, *b*, *b*, *b*, are passed through the corresponding fenestræ, *c*, *c*, *c*, and these two portions of the roller drawn in opposite directions until the edges of the wound are in apposition; (fig. 155.) Then the slits are laid flatly upon the surface,

Fig. 154.

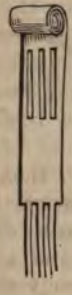


Fig. 155.



and the bandage is completed by circular turns of the roller. The efficacy of this uniting bandage is much increased by the employment of the compresses, which act very much as the quilled suture, by pressing together the entire depth of the sides of the wound. It will be found an advantageous mode of approximating the surfaces of deep incisions of the thighs, particularly.

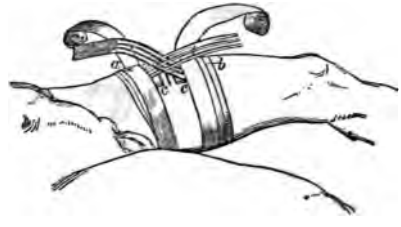
The invaginated bandage for transverse wounds.

Composition. — A piece of linen from two to three feet long, corresponding in breadth with the length of the wound, and divided at one extremity into two or more slits, each about an inch wide and six inches or more in length, to correspond with the same number of fenestræ made in a second piece of linen of the same dimensions as the first; two rollers, each six yards long and two and a half inches wide; together with two graduated compresses.

Application.—The limb having been placed in a position most favourable for relaxing the divided muscles, the surgeon makes a few turns of one roller, *b*, around the limb below the wound, and upon these lays the fenestrated bandage, so that the divided portion stretches upon and across the incision, while the other part rests upon the limb below the wound.

The extremity of this portion is reflected upwards over the turns of the roller, which is now resumed and made to secure the bandage in position.

Fig. 156.



The other band is now confined upon the limb above the wound, in the same manner, by means of the second roller, the slits corresponding in position with the wound: next the compresses, *c*, *c*, are placed parallel with the edges of the incision, one above, and the other below: then the slits of one band are passed through the fenestræ of the other, (fig. 156.) The two bands are drawn in opposite directions, so as to approximate the lips of the wound, and are firmly fixed by turns of the rollers passing respectively above and below the seat of the injury.

CHAPTER VI.

OF THE INTRODUCTION OF THE CATHETER.

A CATHETER, in its most general signification, is an open tube, made usually of silver, or of gum-elastic prepared in a peculiar manner, to which such a form and firmness are given as permit of its introduction into the various canals of the body. The passages into which such an instrument is usually inserted are the lachrymal tube, the eustachian tube, the œsophagus, the urethra, and the large intestine.

FIG. 157.



1. Catheterism, or rather dilatation, of the *lachrymal passages*, is sometimes practised for the purpose of removing obstructions to the escape of the tears along their proper excretory passages. Before resorting to this operation, however, it is important to determine if the difficulty may not be an *Epiphora*, an excessive secretion, rather than a *Stillicidium*.

It is also essential to bear in mind the natural direction of the lachrymal passages, as represented in fig. 157, for it is along these same tortuous channels that the dilating instrument must pass.

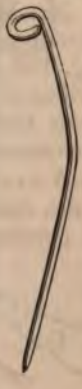
If the *puncta lachrymalia* be occluded, their minute orifices may first be opened by the point of a pin, and then one of Anel's gold probes (fig. 158) may be introduced, or one of the less expensive instruments of which we shall presently speak; the size of the dilator should be gradually increased, until a permanent cure of the stricture has been gained.

It may be that the *lachrymal canals*, leading from the puncta to the sac, are narrowed, in which case the same instrument should be passed along these passages. To dilate the superior canal, the probe must be passed almost perpendicularly upwards, inclining a little outwards, then obliquely inwards and downwards. In operating on the lower canal, pass the probe downwards, then obliquely inwards and upwards.

Fig. 158.



Fig. 159.

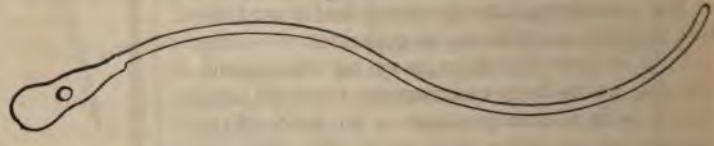


The *Nasal duct*, running from the lachrymal sac to the inferior meatus of the nostril, opening below the inferior turbinated bone, may be diminished in its calibre, and thereby occasion stillicidium lachrymarum. To overcome this obstruction, various methods have been adopted; the most feasible is probably that by dilatation. A series of silver probes should be prepared, four or five inches long, varying in size from that of the No. 17 wire to No. 21, slightly bent, as the one illustrated in fig. 159, or straight, if preferred; one extremity may be turned as in the figure, the other should be slightly pointed, but not sharp, to enter the puncture. In treating stricture of the nasal duct, it is most convenient to pass the probe through the inferior canal, in the manner already explained; and when it has reached the sac, the instrument should be pointed almost vertically downwards until it has gained the inferior meatus of the nose, which may be ascertained readily by passing a probe into the anterior naris of the side operated upon, and touching the one which has been inserted from above. A small sized instrument should be first used, and after having been introduced, should be allowed to remain a few hours, unless much pain be occasioned thereby; and at intervals of four or five days, the same or a larger probe should be passed, the size being gradually increased until the stricture is cured. After each introduction, it is well to apply warm water with laudanum, to allay any irritation which may have been caused. It is im-

portant to avoid any haste, both in the passage of the probe at each sitting, and in increasing the size of the instrument, in order to guard against the production of inflammation.

Mr. Morgan has recommended dilatation of the nasal duct from below, by introducing a probe, such as is represented in fig. 160, beneath the inferior turbinated bone into the lower orifice of the duct. This method is less generally practised than the other, though highly spoken of by Mr. Morgan. (Lectures on the Diseases of the Eye.)

Fig. 160.



Anel advised the syringing of the duct with astringent solutions. To accomplish this, a fine tube must first be passed into the duct from the punctum lachrymale, and the nozzle of the small syringe of Anel be fitted into its upper orifice; when the piston of the syringe is being depressed, the other punctum must be closed by pressure of the finger, otherwise, the fluid will pass out of it from the lachrymal sac. Not much can be effected in this way, however, the tube being too fine to permit any force of injection. Syringing of the duct in this manner, after the use of the probe, may assist the operation of the latter, and is useful also in freeing the passage from mucus.

It should be borne in mind, that very much can be done for the cure of stillicidium, by correcting any temporary congestion or inflammation; frequently, indeed, this affection may be cured without resorting to such mechanical means as we have described.

For farther details concerning these operations, and especially for proper views concerning the pathology of stillicidium, we refer our readers to Treatises on Diseases of the Eye, among the best of which is the American Edition of Mr. Lawrence's book, by Dr. Hays.

2. CATHETERISM OF THE EUSTACHIAN TUBE.

Fig. 161.



The catheter used in this operation is generally of silver, about six inches long, slightly curved at the end which enters the tube, and gradually increasing in size from this to the other extremity. It is open at both ends, and it is of very great importance, that the extremity which is intended to be passed into the canal, shall be well rounded; otherwise, considerable irritation, and even excoriation of the lining membrane of the tube, will be produced. The catheter which Mr. Wilde, of Dublin, one of the most dexterous operators and one of the best authorities, prefers, is represented in fig. 161; it is here shown in its actual dimensions. The ring at the larger extremity of the catheter should be in the same plane as the beak of the instrument, in order that while the latter is being introduced, the operator, by looking at the ring, may know the direction of the beak.

It will be recollected that the pharyngeal orifice of the eustachian tube is, according to Malgaigne, situated at the distance of two inches and a few lines from the anterior orifice of the nostril of the same side, on a line with the external wall of the meatus inferior, and about half way between the floor of the nostril and the inferior spongy bone.

To reach this point with the catheter, the following plan, recommended by M. Gairal, is probably the best: — The patient being seated on a chair, with his head thrown a little backwards and supported upon a pillow, the surgeon stands in front of him and glides the point of the catheter, the instrument having been oiled, along the floor of the nostril of the same side, towards the soft palate: the convexity of the instrument should be directed inwards and upwards, its concavity downwards and outwards. When the point has reached the velum palati, which will be indicated by a movement of deglutition, the shaft of the catheter should

be *rotated through a quarter of a circle*, so as to turn the point outwards and upwards to the same extent, and at the same time pushed backwards for a few lines, when it will have entered the expanded orifice of the tube. (Malgaigne's Operative Surgery, Brittan's translation, p. 314, 315—London, 1846.)

Some surgeons prefer a catheter made of gum-elastic, with a stilet, so that, when the point of the catheter has reached the orifice of the tube, the stilet may be glided into the latter, and the catheter itself slid in upon it. But this we cannot but regard as an improper instrument; for the operator is much more liable to injure the delicate lining membrane of the canal with the stilet; and the withdrawal of the latter, as Mr. Wilde remarks, is very apt to cause the catheter itself, if it have entered the canal, to be disadjusted.

Generally, the simple opening of the tube by the entrance of the instrument, is sufficient to remove any temporary obstruction which may have impeded the free access of air to the tympanum. It is sometimes necessary, however, to resort to injections of air through the catheter: this should be done very gently and cautiously. To accomplish this object, it is necessary to have a properly contrived air-press, from which the air may be injected, and it is also essential that the catheter shall be firmly secured to the head, lest it slip and thereby mischief be done. The air introduced may be the ordinary atmosphere, or it may be some medicated vapour, according to the supposed condition of the lining membrane of the tube.

Eustachian catheterism, certainly, when associated with this farther process, does not properly come under the domain of Minor Surgery. It is a delicate operation, and should not be carelessly or ignorantly undertaken. Before attempting it, more minute instruction should be sought than we pretend to give. We, therefore, refer our readers to the special treatises on aural diseases, the best of which, we think, is Mr. Wilde's.

3. CATHETERISM OF THE ŒSOPHAGUS.—The object of this operation is, to insert a tube into the stomach, for the purpose of removing fluids from this organ, or of introducing them into it. The catheter used is of gum-elastic, of a diameter varying to suit the capacity of different gullets, from two feet to two and a half feet long, and furnished with a flexible stilet made of a thin strip of whalebone; the extrem-

ity which enters the stomach is closed and rounded, but fluids reach the interior of the tube, and escape from it, through two large eyes, placed one on each side, near this end; the other extremity is open and is usually somewhat expanded, to allow of the easy insertion of a syringe-pipe.

The following is the simplest and readiest mode of introducing the instrument: let the patient be seated, if possible, his head thrown back and supported, and his mouth widely opened, and kept open, if necessary, by a piece of wood, or something similar; then the surgeon, taking his position in front of the patient, guides the stomach-end of the tube, previously oiled and having the stilet in its cavity, towards the posterior wall of the pharynx; the stilet should now be withdrawn, in order to allow the tube to curve more readily as the surgeon pushes it downwards through the pharynx and œsophagus. If the patient be possessed of his faculties, and his brain be in a condition to respond to impressions made upon sentient surfaces, the tube will be drawn downwards to the œsophagus by the contraction of the pharyngeal muscles, as in swallowing, so soon as the point of the instrument comes within the sphere of their action; the surgeon therefore is assisted in the performance of the operation, which is thus made much easier. But it happens very often that the patient upon whom the operation is being performed has stupified himself, so that no reflex muscular action takes place. The entrance of the tube into the larynx will be recognised by a spasmodic cough, or by the rushing of the air through the canal thus introduced; the mistake should at once be rectified.

Fluids may be thrown into the stomach through the tube, by means of a common syringe, or of the stomach-pump prepared expressly for this purpose. The first is the most simple and is equally effectual. Care should be exercised that the liquid injected be of a proper temperature.

If the object be to remove liquid matters from the stomach, a certain amount of fluid should be first introduced, either simple tepid water, or some other fluid capable of neutralizing the noxious matter which may have been swallowed; then the whole should be withdrawn by means of the syringe, and the stomach thoroughly cleansed by repeated injections of warm water, or mucilage.

Patients who are unable to swallow, or who obstinately re-

fuse to swallow, food, may be sustained by injections of nutri tious fluids into the stomach through the stomach-tube.

When it is desirable that the tube shall be allowed to remain in the stomach for any length of time, it is recommended to be introduced by the nostril. For this purpose, a tube rather smaller is preferable than if the other method be selected; it is pushed backwards along the floor of the nostril, and when it has reached the edge of the velum, the stilet is withdrawn, and the flexion of the extremity of the tube aided, if necessary, by the finger carried through the mouth. This method is not quite so easy as the first.

4. CATHETERISM OF THE URETHRA.—Very often the urinary-bladder, both of the male and female, becomes distended, being deprived, from a variety of causes, of its natural expulsive power over its contents; in such circumstances, it becomes necessary to resort to some artificial means of relief. In many cases, the difficulty may be overcome by employing remedies which tend to relax spasmodic muscular action, such as a full dose of opium administered by the mouth, or in the form of a small enema;—or an enema of camphor; or, again, a hot bath may be tried; often, too, the operation of a full purgative clyster will be attended with evacuation of the bladder. But where these and similar means fail, it is requisite to introduce the catheter through the urethra into the bladder itself.

CATHETERISM OF THE URETHRA OF THE MALE.—The instrument used for this operation is a cylindrical tube made of silver, or of gum elastic; it should be about nine inches long and of a diameter suited to that of the urethra, which of course varies in size according to the age of the individual and to certain morbid conditions of the canal; the extremity which enters the bladder should be conical in shape, closed at its point, but perforated just above the latter with two or more well-opened eyes; a moderate degree of curvature should also be given to this part of the catheter, though a perfectly straight instrument may be passed through a healthy urethra; the other extremity of the tube is open, and generally has a small ring attached to each side of it, for the purpose of affording means of confining the instrument in the bladder, if occasion require, (fig. 162.) The double catheter represented in fig. 3, will be found a very convenient instrument. When the

Fig. 162.

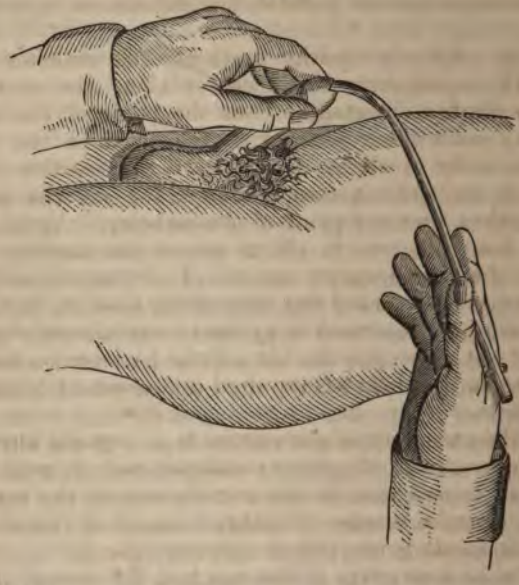


gum elastic catheter is used, the proper curve and firmness are given to it, by bending the iron wire inserted in its cavity.

The following will be found the most convenient method of introducing the catheter, in most cases: The patient should lie upon his back, or be a little inclined towards the right side, his thighs semi-flexed and separated, and his back slightly raised in order to relax the muscles which would, otherwise, somewhat constrict the canal; the surgeon places himself on the left side of the patient, and exposes the head of the penis with the thumb and fore and middle fingers of the left hand, at the same time making slight compression upon the glans penis so as to open the extremity of the urethra; he holds the open end of the catheter, previously warmed and oiled, in his right hand, between the thumb and the fore and middle fingers, the concavity of the instrument looking downwards, and engages its point in the orifice of the canal, the direction of the tube corresponding with the line of flexure of the groin; (fig. 163.) With a moderate degree of force, the instrument, still in this line of direction, is pressed onwards through the canal until its point reaches the membranous portion of the urethra beneath the arch of the pubis, when the right hand of the surgeon, and with it the catheter, is gradually raised and at the same time carried towards the middle line of the abdomen, after which it should be thrown downwards more and more between the thighs; its passage through the circle of the sphincter muscle at the neck of the bladder will be indicated, generally, by a slight shiver, or tremor, or a sensation of nausea, on the part of the patient, and its entrance into the bladder itself by the escape of urine through it; this should be prevented by the application of the thumb upon the open end of the catheter.

With practice, the instrument may be introduced into the bladder, if the urethra be in a healthy condition, without

Fig. 163.



touching the penis at all with the hand, after the point of the catheter has entered the orifice of the canal; and this will be found to be the least painful method to the patient, as well as the one perhaps least liable to obstacles, for the instrument will glide along through the urethra without being deviated by any forced position of the penis. In either method, an instrument of as large a diameter as the urethra will admit will be more easily introduced than a small one.

Some of the French surgeons are fond of practising the "tour de maître," as it is called, and this will sometimes answer when the more common method has failed. The patient may either stand, or lie down, or occupy a sitting posture; the surgeon stations himself on the right side, and carries the instrument down the urethra to the arch of the pubis, with the concavity looking downwards; when it has reached this point, he gives it a turn of a half circle, so as to bring it parallel with the middle line of the body, the

concavity looking upwards; this movement, conjoined with a little pressure, generally causes the instrument to enter the bladder.

Even in perfectly healthy urethras, the catheter often meets with impediments to its course along the canal, but these are readily obviated. Thus the point of the instrument may come in contact with the front of the pubis, owing generally to slight deviation of the position of the penis, or to too great pressure against the superior surface of the urethra from the point of the catheter. Again, when the tube has come within the action of the muscles which compress the membranous portion of the canal, and, still more, when it has reached the neck of the bladder, its farther advance will be often checked by the contraction of the muscular fibres at these points; but a little patience on the part of the surgeon is all that is required to overcome this momentary obstacle.

When the cause of the obstruction is an organic alteration of the urethra, or of the parts connected with it, much more difficulty is experienced in the introduction of the catheter. The most common sources of embarrassment of this kind are stricture and enlargement of the prostate gland.

If there be a stricture of the urethra, the size of the catheter must be adapted to the diminished calibre of the canal; it is necessary, therefore, to have a number of catheters of different sizes always at one's command. The resort to much force in introducing the instrument should be avoided, particularly when the stricture is within the pubic portion of the canal, as a false passage may be made more easily at this portion than in advance of it. The operation may be assisted by drawing the urethra over the catheter; by first using a large instrument, until the stricture is reached, and then drawing the penis over it, so as to make an entrance fully into the strictured part, then taking a smaller instrument with a resort to the same manipulation. The use of the warm-bath, the application of warm fomentations to the perinæum, or the administration of anodyne enemata, or inducing anæsthesia by inhalations of ether or chloroform, will usually assist the operation, by relaxing the muscles which directly or indirectly constrict the urethra. In the London Lancet, for 1851, Mr. Thomas Wakley describes a method of effecting

prompt dilatation of the urethra which may prove very serviceable in affording relief to persons suffering from retention of urine, with stricture. He employs a series of instruments. He first introduces a very fine bougie, and upon this, as on a director, a small catheter, and so on, gradually increasing the size of the catheter, until one of sufficient dimensions has been passed.

M. Amussat frequently resorts to forced injections of the urethra, to relieve retention caused by stricture. He introduces a catheter of gum-elastic, open at both ends, as far as the stricture, and then, by means of a syringe, forces a stream of warm water along the urethra; this removes any mucus which may have collected, and dilates the canal somewhat, so that the patient can generally pass a small quantity of urine.

One of the most common causes of difficulty in the introduction of the catheter, particularly in old men, is an abnormal development of the prostate gland. The middle lobe becomes enlarged, sometimes to a very great degree, and encroaches, proportionally to its size, upon the canal at the neck of the bladder, thereby opposing a mechanical obstacle to the ingress of the instrument. (Fig. 164.) There are

Fig. 164.



several expedients by which this difficulty may generally be remedied. If the gland be not very large, a silver catheter may usually be passed, by pressing the external end of the instrument well downwards, when the point has reached the

prostate; or a gum-elastic catheter may be introduced by withdrawing the stilet a little, when the prostatic part of the urethra has been attained, and pushing the tube onwards with moderate force and cautiously; the point of the instrument, meeting with the obstacle, will yield to it in virtue of the flexibility of the gum, and will be thrown upwards so as to clear the obstruction. If these methods fail, the surgeon should insert the forefinger of his left hand, previously oiled, into the rectum, and press the point of the catheter upwards towards the pubis: if the gland is very large, the patient should assume the erect position, or he may bend his body forwards, supporting his hands against the back of a chair or a table, so that the mere weight of the prostate will open the neck of the bladder to the passage of the instrument. In cases of obstruction from this cause, the curve of the catheter should be somewhat increased, especially near its point, so that it will pass over, and in advance of, the enlarged gland, instead of impinging directly against it, as would probably be the case were the degree of curvature smaller.

Many persons suffer very much from the performance of this operation, even where there is no stricture; others, again, experience severe rigors, or fainting-fits. If these peculiarities be known to exist, it is better, unless contra-indicated, to put the patient under the influence of ether, or to diminish their sensibility by opium; and if such effects follow the operation, morphia should be given to allay them. And in all difficult or protracted cases, the same expedients may be resorted to with great advantage.

Where much difficulty is experienced in introducing the catheter, or in the process of dilating a stricture, it is often advisable to allow the instrument to remain in the bladder. A silver catheter is borne with rather less comfort than a gum-elastic, but the latter soon becomes corroded and roughened by the action of the urine upon it; hence if the gum catheter is used, it should be removed at least once in every twenty-four hours, and a new one substituted for it.

A very simple mode of securing the catheter in the bladder is the following: pass a ring made of ivory or of metal, covered with linen, or of a cylinder of linen stuffed with cotton, over the penis, and secure it against the pubis by means of four tapes passing around the pelvis and between

the thighs, on each side; attach the catheter to this ring by tapes connected with the rings of the instrument, or tied around its extremity, if it be a gum-elastic tube.

Fig. 165.



M. Velpeau advises that a piece of linen be passed around the penis, just behind the corona glandis, and that four tapes, secured to the rings of the instrument, or tied around the extremity, be twined about it. (Fig. 165.) The first plan will be less likely to cause injury to the penis, in case of erection of the organ.

Catheterism of the female urethra is attended with fewer difficulties than that of the male, owing chiefly to the difference in the conformation of the two canals.

The instrument employed in the operation is made of silver, generally; its form and dimensions may be very well seen by a reference to fig. 3, A and B, and to the text explanatory of it. But a gum-elastic catheter, even without a stilet, may easily be introduced. The only difficulty in the performance of the operation, in most instances, consists in inserting the point of the catheter into the orifice of the urethra, without exposing the parts; but a very little practice upon the subject will enable the surgeon to acquire sufficient skill to operate satisfactorily on the living female.

The simplest rule which can be given for ascertaining the position of the orifice of the urethra in the female is this: (the patient being on her back,) introduce the tip of the forefinger of the right hand within the labia and the orifice of the vagina, and press its palmar surface against the summit of the arch of the pubis, at the same time pushing the point of the finger a little forwards; it will now readily and immediately feel itself entering the mouth of the canal, which is forced a little open to admit its tip.

The catheter may be thus introduced: place the point of the forefinger of the right hand at the orifice of the urethra, as just directed, and with the left hand enter the catheter, using the finger of the right hand as a guide; or only one hand need be employed, thus: lay the catheter upon the palm

of the right hand, the point of the instrument resting on the top of the forefinger, the other extremity on the ball of the thumb, and supported in this position by the thumb and middle-finger, both somewhat flexed; now place the tip of the forefinger at the orifice of the urethra, in the manner already directed, and with the thumb and middle-finger cause the catheter to glide along upon the fore-finger and enter the canal.

When the uterus is higher up in the pelvis than usual, from any cause, the orifice of the urethra is usually drawn behind the arch of the pubis; in such cases, the point of the finger must be introduced a little farther than is otherwise necessary, in ascertaining the position of the meatus, and rather behind the pubis; but the operation is scarcely rendered more difficult on this account.

It sometimes happens that the urethra is much compressed against the pubis by a tumour in the pelvis, as a child's head during labour; in such circumstances, if it is necessary to remove the urine from the bladder, a gum-elastic catheter of small size should be used, or, which is perhaps better, a flattened silver catheter; such an instrument can be had at the shops of surgical instrument makers.

Should it be deemed advisable to allow the catheter to remain for any length of time in the bladder, it may be easily secured by applying a double-T bandage around the pelvis, and attaching the rings of the instrument to the strips which pass between the thighs and over the perinæum.

5. CATHETERISM OF THE LARGE INTESTINE is sometimes resorted to, for the purpose of removing the gases which accumulate so largely in some diseases. Thus, in peritonitis, the bowels often become so much distended with flatus, as to aggravate the patient's suffering in a high degree. In such cases, relief is occasionally obtained from the introduction of the common stomach-tube. The mode of performing the operation is simple in the extreme; and yet, from the tortuous course of the intestinal canal, it is often exceedingly difficult to pass the tube to any considerable distance above the rectum. The most successful plan is to select a large-sized stomach-tube, having within it a stilet of whalebone sufficiently thick to impart to the tube a certain degree of firmness, yet so flexible as to accommodate itself to the winding course of

the canal; the tube should be oiled, and introduced with a rotatory motion and slowly: the point of the catheter may often be felt passing along the sigmoid flexure of the colon, by the hand placed on the parietes of the abdomen. If the operator fail in his first attempt, he should change the position of the patient, and make another effort. It is sometimes useful, when the farther advance of the tube seems to be prevented, to throw a stream of tepid water through it from a syringe inserted into its trumpet-shaped orifice.

6. CATHETERISM OF THE LARYNX AND TRACHEA is rarely practised; but in some cases of œdema of the glottis and similar obstructions, it may perhaps be advisable to pass a tube into the air-passages from the mouth. The operation is more difficult of execution than catheterism of the œsophagus; sometimes, indeed, it is impossible, as when the rima glottidis is spasmodically closed: the patient being seated, or recumbent, the head should be thrown back, the mouth widely opened, and the base of the tongue depressed by means of a spoon; then the surgeon, taking a silver tube curved like the ordinary catheter for the urethra, but rather larger and open at both ends, or a stomach-tube curved by means of a stilet, passes it through the mouth directly into the larynx, the patient being directed to prolong his inspiratory act: a momentary cough may be excited by the entrance of the tube into the larynx, but this may soon subside, so that the instrument may be permitted to remain, having been secured by attaching its external end to some conveniently-placed bandage, as around the neck, for example.

CHAPTER VII.

ON THE ADMINISTRATION OF INJECTIONS.

THE term injections, or enemata, is applied to liquids introduced into the canals or cavities of the body by means of syringes contrived for the purpose.

The matter of the injection consists of water, holding in solution, or suspension, certain medicinal substances, intended to produce some special effect,—or of water alone.

The syringes used in the administration of enemata vary in form and size, according to the amount of fluid to be injected, and the canal into which it is to be introduced. The rectum, the vagina, the urethra, and the lachrymal duct are the passages which are most frequently acted upon in this manner.

1. Injections by the rectum.

The syringes for the rectum are made of different sizes, to contain from two fluid ounces to a pint, or more. In selecting them, those instruments should be chosen of which the beaks are large and well-rounded at the extremity, so that there shall be less probability of inflicting any injury upon the mucous membrane of the rectum during their introduction.

Before using the syringe, the beak should be warmed and anointed with oil, or lard; and when it is being introduced into the rectum, great gentleness and caution should be observed, otherwise, as has happened at times, the intestine may be torn, or even perforated, particularly when its coats are not in a perfectly healthy condition. Its entrance into the anus may be facilitated by first passing in the forefinger of the left hand, well oiled, and then sliding in the beak upon it. While the piston is being forced down with the right hand, the head of the syringe should be firmly held by the fingers of the left, so that the instrument shall not be pushed further into the bowel. The fluid should be forced from the tube gradually; and after all has been ejected, the beak of

the instrument should be retained a few moments in the rectum, lest, during its removal, the injection pass out with it.

The above remarks are of general applicability: there are some modifications of the process, however, which should be borne in mind. Thus, it is frequently advisable that a large quantity of fluid shall be thrown into the bowel, a larger quantity than can be contained in the syringe usually employed. In such cases, the instrument must be carefully and slowly withdrawn from the anus, refilled, and again introduced and emptied, until the requisite amount shall have been injected; or, the self-injecting syringe may be more conveniently used —an instrument made like the common forcing pump, having connected with it one tube, through which the fluid enters the syringe from the vessel which contains it, and a second, which is inserted into the rectum, and through which the injection finds its way into the bowel. With this very convenient apparatus, any quantity of fluid may be thrown into the large intestine, until it is filled, either by the patient's self or by an attendant. Again, it sometimes happens that an obstruction of the lower part of the bowel prevents the introduction of the matter of the injection beyond a certain point, if the ordinary method be adopted. In such cases, it is customary to pass a stomach tube, in the manner recommended in the last chapter, as far into the canal as may be practicable, and to inject the fluid through it. This method will be found effectual, oftentimes, in overcoming the constipation which attends some cases of colic.

The composition of the enema must be adapted to answer the particular indication for which it is given. When it is employed merely to distend the bowel by its quantity, simple warm water, or warm mucilage, may be used. The ordinary purgative injection consists of a tablespoonful of common salt and the same bulk of molasses, dissolved in a pint of warm water, to which a small piece of soap may be added with advantage. The anodyne enema consists merely of half an ounce or an ounce of mucilage, holding in suspension or solution the anodyne element,—as, for example, thirty-five or forty drops of laudanum. This small quantity of fluid is preferred, as being less likely to induce contraction of the expulsive muscles by its mere presence, than if a larger amount were introduced; and this fact should be recollected in giving any injec

tion which is intended to be retained in the rectum, to produce some general impression upon the economy.

"*Suppositories*" are sometimes used as substitutes for enemata: they may be so formed as either to induce an evacuation of the lower bowel, from the irritation of their presence in the rectum,—or, in consequence of the absorption of the medicated materials of which they are composed, they may be retained for a considerable length of time in the gut, and produce the peculiar effect of the medicine upon the system.

The suppository intended to produce catharsis is ordinarily made of a piece of castile soap cut to correspond with the form and size of the rectum; it should be oiled, and then inserted gently within the sphincter muscle.

Any medicine may be administered in the form of a suppository, by combining it, in the state of powder, with liquorice, cocoa-butter, or some other soft adhesive substance; then, having reduced the mass to the proper dimensions and figure, let it be oiled and introduced into the lower extremity of the rectum. As a general rule, the quantity of the medicine used in the suppository may be three or four times greater than the proportion of the same medicine, when given by the mouth.

It should be borne in mind that a very frequent resort to the employment of suppositories, or to the administration of injections, produces irritation of the mucous membrane lining the lower part of the rectum, and is apparently an exciting cause of the development of hæmorrhoids and other organic alterations of this portion of the intestinal canal.

2. Injections by the vagina.

The vaginal syringe is usually about four inches long and an inch in diameter, terminating in a rounded head which is pierced with a number of holes, like a sieve.

No especial directions are required to enable one to introduce this instrument, farther than that it should be oiled before so doing.

The cavity of the uterus itself may be washed, by passing a gum-elastic catheter through the os uteri, and injecting the interior of the organ with tepid water or mucilage, by means of an ordinary syringe, of which the beak is inserted into the open extremity of the catheter.

3. Injections by the urethra.

A small glass syringe capable of containing about half an ounce, and having a beak well rounded at the tip, is the best instrument for injecting the urethra. The piston should terminate, at its free extremity, in a ring large enough to receive the thumb, so that the fluid may be forced from the syringe and the syringe itself held by the right hand, while the left supports the penis. The beak of the instrument should be oiled and inserted very carefully into the orifice of the urethra, lest the lining membrane be injured.

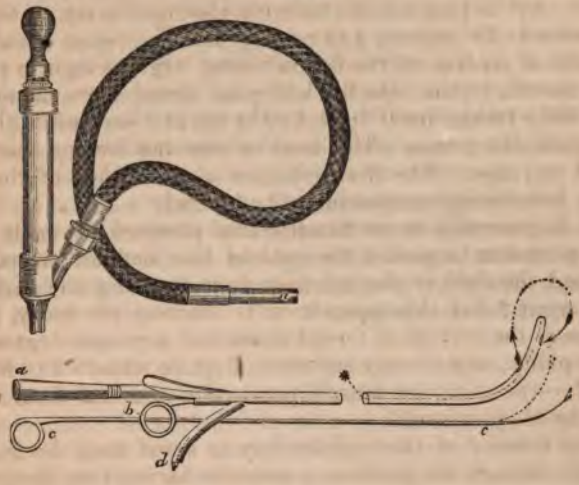
It is generally recommended that pressure be made upon the perinæum opposite the neck of the bladder, in order to prevent the fluid of the injection from entering the cavity of this organ; but this precaution is scarcely necessary, if the piston of the syringe is forced down with a proper degree only of rapidity, and if only sufficient fluid be expelled to fill the canal,—the sphincter muscle preventing the fluid from reaching the bladder itself.

The interior of the bladder may be acted upon by fluid injected through the urethra, a catheter having been first introduced, and the beak of an ordinary syringe, or a gum-elastic bag, then inserted into the mouth of the tube. But it is much more convenient to use a catheter having two passages, as in fig. 166. In the drawing the division of the tube is indicated by the dotted line and the star; at *a* the nozzle of the syringe (*a*) is received; the fluid from the latter passes along to the bladder through the eye marked by one of the arrows, and is returned from the bladder through that marked by the other, to escape from the catheter by *d*. The stilet *c* is for the purpose of removing any obstruction which may occur in the catheter; it is made of steel, so thin and flexible as to be capable of being readily pushed into the chambers of the instrument, as indicated by the dotted curved line. (See Mr. Fergusson's book, p. 588.)

Care should be taken, that the fluid thus introduced into the bladder has been freed from all solid matter which, if retained, would serve as the nucleus for calculous formations; it should, moreover, be tepid in temperature, and of a slightly mucilaginous character.

In injecting the urethra of the female, a catheter should first be inserted within the orifice of the canal, the beak of the

Fig. 166.



syringe adapted to it, and then the fluid forced through the tube into the urethra.

4. Injection by the lachrymal duct.

The instrument by means of which this is accomplished, is known by the name of "Anel's syringe;" it is a small syringe having a number of very fine tubes appertaining to it, one of which, when the duct is to be injected, is attached to the beak of the syringe and then inserted into the inferior puncture lachrymal. The method of using the instrument is thus described by Malgaigne: "Seat the patient opposite the light. If you operate on the left eye, stand before him, and with the thumb or fingers of your left hand draw the lower lid outwards and a little downwards, so as to direct the lachrymal puncture forwards and outwards. Then, having filled the syringe and applied one of the small tubes to the beak, hold the instrument as a pen in your right hand, which you rest on the cheek, and carefully insert the end of the tube in the puncture; first, obliquely downwards and inwards, then, after having entered one line, directly inwards. At the distance of three and a half lines you may stop, but it is advisable to penetrate as far as four and a half lines, in order to reach the

sac; then inject slowly, at first." On the right eye the operation may be performed also with the right hand, by standing behind the patient, and resting the hand upon the external orbital process of the frontal bone. If the duct is pervious, the fluid thus injected will pass through it and appear externally by the nostril; and if it be not pervious at first, the obstruction may oftentimes be removed by repeated use of the syringe. The first injection should consist of tepid water or mucilage; subsequently, the fluid may be rendered somewhat astringent, or be otherwise medicated. If the injection cannot be passed through the duct, a fine silver probe, of which the point is round and smooth, may be introduced as directed for the syringe.

CHAPTER VIII.

ON THE REMOVAL OF FOREIGN BODIES FROM THE NATURAL CANALS AND PASSAGES.

1. THE GLOBE OF THE EYE, from its exposed position, is very liable to have foreign bodies, as particles of dust, cinders, and minute insects, come in contact with it; not unfrequently, also, sharp splinters of iron or steel are driven forcibly against it and imbed themselves. The pain in such instances is considerable, sometimes excruciating; more or less profuse lachrymation takes place, and the patient is unable for a time to make use of the eye without discomfort.

Frequently, the profuse secretion and escape of tears are sufficient to wash away the offending substance, aided by the friction which the patient almost unwillingly exercises. When not thus removed, the lids should be well opened and the globe carefully examined, while the patient rolls the eye-ball in various directions; if the object be thus brought into view, it may be removed by the point of a camel's-hair pencil, by the corner of a pocket handkerchief, the end of a tooth-pick or probe; or it may be necessary to throw a fine stream of tepid water gently between the lids; or, finally, if a particle of metal or such body be adherent to the structure, it must be removed by a pair of delicate forceps, or by the point of a cataract needle; in such cases a magnet would hardly accomplish the removal.

Very generally the offending object will not be detected by the examination to which we have alluded; it will then be necessary to scrutinize the inner surface of the *eye-lids*. The lining membrane of the lower lid may be readily seen by depressing the lid, at the same time that the patient rolls the eye upwards; to expose the conjunctiva of the upper lid, the surgeon should seize the lashes, and by these draw the lid a little off from the globe, place a probe, a tooth-pick, or some similar instrument, across the lid just above the superior border of the cartilage and parallel thereto, and, while the patient looks downwards as much as possible, throw the lid

over the probe, thus turning it "inside out;" all these steps are done at once. If the object be seen, it may be removed by any of the means above indicated.

It must be recollected that the sense of itching, pain, &c., occasioned by the pressure of the irritating substance, usually remains some time after the cause has been removed. This disturbance, however, will commonly be relieved by the application upon the closed lids of tepid or cold water, as is most agreeable to the patient.

2. REMOVAL OF FOREIGN SUBSTANCES FROM THE NOSTRIL. — Children are not inapt to thrust beans, coffee grains, buttons, and such small bodies, into their own or others' nostrils, in fun or malice; or they may be drawn up into the nose by smelling them strongly. Careless or ignorant manipulation, instead of dislodging them, only forces them farther towards the summit of the nasal chamber. The lining membrane of the nose becomes swollen, in consequence of the pressure of the irritant and of the efforts made to remove it, blood flows more or less freely from the ruptured vessels, and the cavities become additionally occluded by clots of blood. When the surgeon is sent for he finds the inside, and perhaps also the exterior, of the organ swollen, and is unable to see the offending substance. In such a case, it is best to syringe the nose with tepid water, to dislodge coagula of blood, and inspissated mucus which obscure the cavity; perhaps the same means will likewise loosen and wash down the foreign body; if not, let the surgeon pass a flattened probe, slightly curved, into the nose beyond the object, and endeavour to drag it downwards; the spoon-shaped extremity of the silver director will answer this purpose very well; or the substance may sometimes be caught in the noose of a wire-armed canula. Either of these instruments will be more likely to succeed in engaging the object sought than the forceps, for the latter cannot usually be worked with advantage, and even if the foreign substance be grasped, it will slip from the blades repeatedly.

If it be not thrust high up in the nose, and only loosely fixed, it may be dislodged by exciting violent sneezing, the other nostril being closed the while.

Occasionally, children are so much frightened by the accident and the efforts made to relieve them, as to be entirely unmanageable, and thereby expose themselves to injury from

attempts at extraction of the foreign body. It is better, under these circumstances, to quiet the patient by inhalations of ether, and then resume the operation under more favourable auspices, or to wait until the dread shall have passed off. There is usually, however, no such difficulty.

Soothing applications should be made after the operation, if the local symptoms seem to require any interference.

3. EXTRACTION OF FOREIGN BODIES FROM THE EXTERNAL MEATUS OF THE EAR.—The lining membrane of the external auditory passage, especially near the membrana tympani, is so exquisitely sensitive, that great pain and irritation, sometimes convulsions, are produced by the entrance of foreign substances. Insects, the most common of which is the "*ear-wig*," splinters, small pebbles, &c., &c., are not unfrequently introduced, or insinuate themselves into the external ear. Attempts to remove them should be made with great delicacy, as very unpleasant consequences have often followed carelessness and rudeness.

FIG. 167



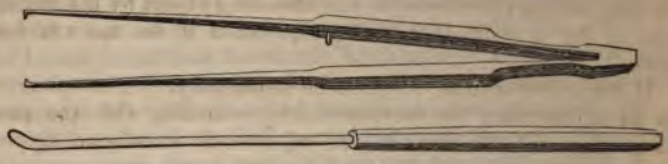
The passage should be examined by the aid of the speculum, such as is represented in fig. 167, a conical silver tube carefully smoothed, and brightly polished on the inner surface, or the little gorget-like instrument shown in fig. 168; and if the object be seen, it may,

FIG. 168.



erhaps, be removed by a flattened silver probe, slightly curved, or the scoop-shaped end of a director, or the little curette, or the delicate forceps, used by Mr. Wilde. (Fig. 169.) In consequence of the straightness of the passage, however, the surgeon may not be able to manipulate conveniently with, or guide, any of the instruments to which we

Fig. 169.



have alluded, his hand being in the way of his vision; he will then find the forceps illustrated in fig. 170, more manageable.

Fig. 170.



But in most cases, more can be done, perhaps, by means of a syringe and tepid water, than by any other instrument, and with less danger of injuring the patient; this is particularly true if an insect have found its way into the meatus, or if wax have became impacted therein.

It is necessary to guard against inflammation, both before and after the removal of foreign bodies from this situation. (See Wilde's Aural Surgery.)

4. Foreign bodies occasionally become lodged in the *Pharynx* and *Œsophagus*. Small objects, such as pins, buttons, fish bones, are apt to become arrested in the folds and pouches at the base of the tongue and palate, causing considerable uneasiness and constant coughing and hawking, rather than actual strangling; while bodies of larger size are caught at the narrowest part of the pharynx, and by their pressure upon the larynx, or the spasmodic irritation which they produce in it, endanger suffocation.

The exact point of lodgement should first be ascertained, by careful exploration with the fore-finger of the right hand, as well as by the eye, of the surgeon — the patient's mouth

being widely opened. The situation having been determined, the surgeon may best remove the offending object by his finger-nail, or by a pair of dressing-forceps, if it be not too low down.

If the substance in question be impacted in the œsophagus, its situation must be ascertained by sounding with the probang, (fig. 171,) a flexible rod of smooth whalebone, tipped

Fig. 171.



with a sponge, or rounded block of ivory; if it be low down, near the stomach, probably the best course to pursue is to push it still onward into this cavity, by means of the probang; if it be nearer to the pharynx and accessible to instruments, the effort should be made to seize it with the gullet-forceps, as represented in fig. 172; or, instead of the forceps,

Fig. 172.



a hook attached to a whalebone, as is exhibited in fig. 173,

Fig. 173.



may be passed between the body and the wall of the œsophagus, and then, when it is beyond the former, drawn up again: the instrument being provided with a hinge, which permits its blades to close as it is pressed between the gullet and the foreign body, while they open again when the pressure is removed, and thus entangle the latter.

Fig. 174.



But a much more simple and effectual hook is that contrived by Dr. Bond, of this city (fig. 174); it is so simple that many may be inclined to think little of it. It is longer than the common gullet-hook, and sets out rather more from the stem at its extremity, while at its commencement it forms quite an acute angle with the shaft, and is thus capable of engaging objects so small as a pin or a needle. It is made upon a piece of copper wire, silvered, or upon a piece of silver wire, long enough to reach even to the stomach, and sufficiently flexible to be moulded to any shape. It will be found to be a most efficient instrument; indeed, one can accomplish more with it than with any other means.

It is very well to have two pair of gullet-forceps, opening in opposite directions, as those figured by Professor Miller, (fig. 175); in these, it will be observed, the inner face of each blade is flat, and toothed near the extremity. Dr. Bond has also contrived a gullet-forceps, (see fig. 176), the inner face of whose blades are levelled off towards each other, and toothed; and they are so set that they do not come together closely; consequently, there is but little probability of catching the lining membrane of the œsophagus between them.

Fig. 175.

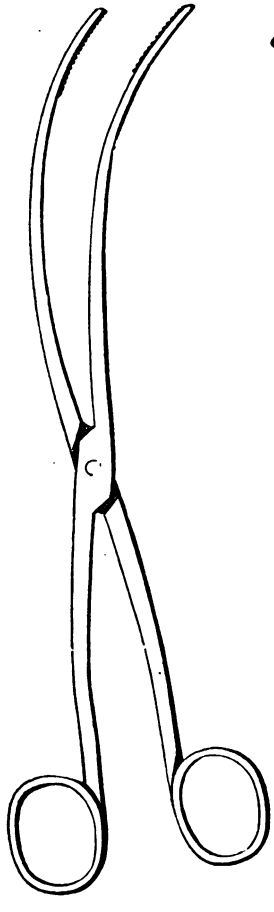
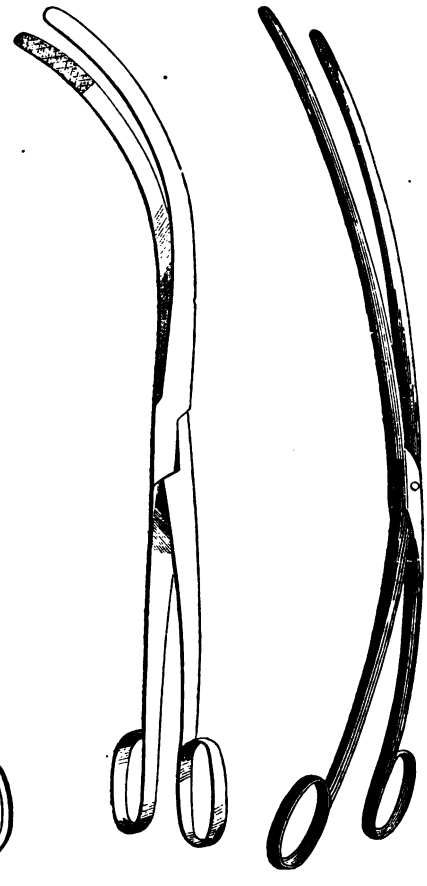


Fig. 176.



These forceps are in general use in this city, and are preferable, we think, to all others. (See an interesting paper by Dr. Bond, in the North American Med. and Surg. Journal, vol. vi., in which he describes both the forceps and the hook.)

Sometimes, though happily very rarely, it is impossible either to draw the body upwards, or to force it into the sto-

mach; then, if the symptoms be urgent, it remains only to make an incision upon it at the side of the neck, and remove it from without.

If the foreign substance be withdrawn from the gullet, it is advisable always that the patient should make use of some mucilaginous article, as slippery-elm bark, or gum arabic, to lubricate the lining membrane and to protect it, while so recently irritated, from farther annoyance during the passage of alimentary substances. And if the offending object have been pressed down into the stomach, especially if it be irritating, unless it be chemically so, rather than give purgative medicines to promote its evacuation per anum, demulcients and mucilages should be taken freely by the patient, in the hope that it may become more or less ensheathed, and thus be rendered harmless: if it be likely to do mischief by chemical action, the proper antidote should be promptly and sufficiently administered.

5. EXTRACTION OF FOREIGN BODIES FROM THE LARYNX AND TRACHEA.—During the act of inspiration, the glottis is opened widely for the ingress of air, while but a narrow chink remains during expiration. Hence, during a fit of crying, laughing, coughing, yawning, or the like, the unusual inward rush of air often suffices to suck in, so to speak, bodies of considerable size. Among the articles which have been thus drawn into the trachea, are pieces of money, (a half sovereign, for example,) cherry and plum stones, small pebbles, grains of coffee and corn, teeth, (in one instance, a large molar with its fangs,) pieces of grass, fragments of bone. The object once in, escape is difficult, from the diminished size of the orifice, but especially from the spasmodic closure of the glottis, which the presence of an irritant almost necessarily induces.

The symptoms produced by this accident vary according to the position occupied by the intruder. If it be fixed in the rima glottidis, asphyxia is rapidly produced, and speedy loss of consciousness and death, unless relief is procured by surgical interference. If it be moveable in the larynx and trachea, and if it change its position from time to time, these alterations of site may occasion violent spasmodic cough, continuing until complete exhaustion is produced, when a temporary cessation occurs, to be followed, upon revival, by the same phenomena. In other cases, the cough is only occa-

sional and much less violent, resembling more the paroxysms of hooping-cough; again, it is more like that which attends an ordinary catarrh, or a pneumonia, so as to be mistaken for one of these; the nature of the expectoration is also similar to that of these affections. Auscultation will aid the recognition both of the cause of these aberrations, if the history have been unknown, and of the portion of the body, especially if it be impacted anywhere, because such a condition almost always occasions local pneumonia, or collapse of that portion of the pulmonary structure which is connected with the bronchial tube thus occluded. Frequently, too, the existence of the foreign body in the trachea and larynx, may be recognised by feeling it with the fingers placed on the outside of the passage, and its motions up and down in the tube may thus be followed. Besides the local symptoms enumerated, the general condition of the patient suffers, he becomes emaciated, feverish, &c.; in fact, many persons who have accidentally had a foreign body lodged in the trachea, have been supposed to labour under tuberculous diseases of the lungs.

The cause of all these troubles may remain entangled in the ventricles and folds of the larynx, or be impacted in its general cavity, or in that of the trachea; it may have passed into one of the bronchia, the right most probably, because of the size and direction of the latter; it may even slip farther down into one of the smaller subdivisions of the bronchial tubes; or it may, as we before hinted, be arrested at the chink of the glottis, either at its first descent, or subsequently during expiration.

Before resorting to mechanical interference, the surgeon should satisfy himself by careful investigation into the history, as well as the present phenomena, of the case, that a foreign body has passed into the respiratory canal, and that the symptoms are not due to inflammation, nor to impaction in the œsophagus or pharynx.

Clearly, the attempt at removal of the object in question, by forceps passed into the larynx and trachea, is out of the question. The surgeon must decide between performing tracheotomy and laryngotomy; and removing the body through the wound, on the one hand, and trusting to the expulsive efforts of the patient, aided by the surgeon. The first of

these proceedings does not concern us in this treatise; we refer our readers to works on practical surgery.

As regards the second course, it is very encouraging to find that Nature does often accomplish the extrication of the patient from circumstances of great peril; but the surgeon should be prepared to step in at any moment and perform the operation, if suffocation be imminent, or if there seem to be a probability that the longer sojourn of the foreign body in its abnormal situation will cause the death of the patient by the irritation, inflammation and exhaustion, which it occasions.

If violent spasmodic cough be induced at any time, without tending to cause the extrusion of the foreign body, but serving only to wear out the patient's strength, it may be well to try the effect of anæsthetic inhalation, to diminish the sensibility of the air-passages, unless the substance be supposed to be impacted at the glottis; and even then, the inhalation might have the effect of extricating it from its present position by relaxing the muscular spasm. Again, if a violent fit of coughing be induced, the patient should be inverted, and at the same time struck smartly between his shoulders; by these simple means the air-passages have been relieved of their troublesome occupant.

In the well known case of Mr. Brunel, the engineer of the Thames tunnel, an apparatus was constructed, with a hinge in its centre, upon which he was extended; so that one end being elevated, the other was depressed, and thus the patient was inverted with as little suffering and fatigue to himself as possible. Tracheotomy was performed by Sir B. Brodie, but all efforts to remove the foreign body (a half sovereign), by forceps introduced through the wound, were unsuccessful; the wound, however, was kept open, and on the 16th day after the operation, the patient being extended upon his platform, by dint of striking his back sharply, the coin quitted the trachea and fell into *the mouth*.

In conclusion, we may say with Mr. Fergusson, that such examples as this, of which there are several on record, "clearly indicate the propriety of trying the effect of change of attitude in such cases; for when we reflect how often persons have died in consequence of the pressure of foreign bodies in the air-passages, and how, too, occasionally such

bodies have been spit up after months or years of almost continued coughing and suffering, it is not unreasonable to suppose that such a change of attitude, and some such additional measures as were resorted to by the gentlemen who conducted the treatment of the instances above referred to, might have saved many lives."

For farther details on this important subject, we refer to Dr. Gross' valuable monograph on "Foreign Bodies in the Air-Passages," Philadelphia, 1854; Dr. Stokes's book on Diseases of the Chest; to an interesting paper by Dr. Davis, in the New York "American Monthly," August, 1854; to Brodie's case, London Medical Gazette, July, 1843; and to Mr. Porter's treatise on the Larynx and Trachea.

6. Removal of foreign bodies from the Urethra. — The urethra of both sexes is liable to be blocked up, more or less effectually, by the lodgement therein of fragments of calculi, portions of catheters or bougies which have been broken during operations, or by foreign substances introduced from malicious or otherwise improper motives. The seat of the obstruction varies—it may exist at any point. The symptoms are, more or less complete retention of urine, local inflammation and pain. The precise point of obstruction can be ascertained sometimes by manipulation of the exterior of the canal; more certainly by the introduction of a catheter or bougie.

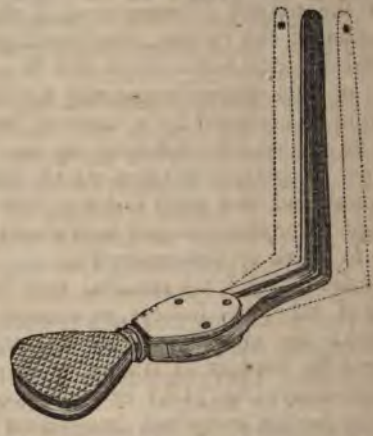
To remove the foreign body, it will be necessary sometimes to resort to many expedients. The simplest is to introduce the largest sized bougie or catheter down to the substance, hoping that by this great dilatation of the canal in advance of the latter, it may be disengaged and forced out by the pressure of the urine from behind; or the ingenious little instrument of Leroy d'Etiolles, should be passed behind the impediment, then its arm thrown down, and both withdrawn; or, again, a long slender urethral forceps, such as is shown in fig. 177, may be passed up to the obstacle, and efforts made to grasp the latter with it, and if necessary the body may be

Fig. 177.



drilled or crushed at the same time. If the impediment be located near the orifice of the urethra, it may perhaps be seized with a pair of delicate dressing-forceps, or a loop of wire, or be drawn out by means of a bent probe; or the canal may be dilated by the aid of Arnott's fluid dilator, or Weiss' metallic dilator. (Fig. 178.)

Fig. 178.



If none of these experiments be successful, nothing remains save to cut down upon the foreign body and extract it through the wound. This proceeding, however, will rarely be necessary in the case of the female urethra, foreign bodies being extricated from it with comparative facility, owing to its straightness, shortness and capacity for dilatation.

7. Removal of foreign bodies from the Vagina, can generally be accomplished without difficulty, if patience and gentleness be used, together with a sufficiency of olive oil. The passage is susceptible of very considerable dilatation, and consequently it can rarely be necessary to divide its walls with a cutting instrument; the forceps and lever employed in obstetric operations, may also be resorted to advantageously in the case in consideration.

8. Removal of foreign bodies from the Rectum.— Indigestible substances occasionally pass down from the upper part of the alimentary canal, and become arrested in the

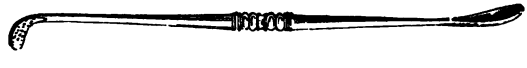
rectum; or from morbid sensibility of the mucous membrane, and a resulting spasmodic stricture of the orifice of the gut, fæces accumulate in large masses, so as not only to exercise a prejudicial influence upon digestion, but likewise to encroach upon the other organs contained in the pelvis; or, finally, bodies, various in kind and size, may be introduced into the canal from without.

To ascertain the nature, dimensions and situation of the abnormal contents of the rectum, the fore-finger, well oiled, should be passed into the bowel, or if this be not sufficiently long, a metallic or gum-elastic bougie may be introduced.

If the intestine be occluded by a mass of hardened fæcal matter, it may be removed by throwing up an abundance of tepid water from a syringe or gum-elastic bag, which will soften the accumulation and wash it down little by little; or a scoop, a tea-spoon, or some similar instrument may be carefully employed to break up the concretion.

If the substance be solid, its removal may be effected by means of a pair of lithotomy forceps, or a small lever, such as obstetricians make use of, but reduced in size, or the scoop employed to clear the bladder of fragments of sand after the operation of lithotomy, (fig. 179,) or a loop of wire, introduced beyond the foreign body and then drawn out.

Fig. 179.



If the object be very large, it may be drilled to fragments or crushed, as was done by Dr. Parker, of Canton, in the case of the large glass goblet introduced into the rectum of a Chinaman, reported by Dr. Ruschenberger in the American Medical Journal, April, 1849; or the sphincter ani muscle may be divided, and thus extraction be facilitated.

OF THE MEANS OF DIMINISHING PAIN DURING OPERATIONS.

Pain is at all times an inconvenience, and often a positive evil both to the surgeon and to the patient who is undergoing an operation, since it interferes with the quiescence which is essential to the performance of some operations and of importance in all; and, moreover, if it be very violent and protracted, it may produce such an impression upon the patient, as shall impair the success of the operation, during its performance and subsequently. Hence the very general custom of administering to patients who are about to submit to surgical operations "some sweet, oblivious antidote," for the purpose of calming their apprehensions of suffering and danger, and to obtund, in a measure, their sensibility to pain, so that the operation may be performed with less discomfort to themselves and with more facility to the surgeon, than might otherwise be possible.

With this view, it has been usual to give a dose of one of the preparations of opium, a short time previous to the operation, so that, when this is being performed, the patient may be under the influence of the anodyne, not to such a degree as shall completely stupify him, but so far as to be calmed and tranquillized by it. The precise amount of opium necessary to induce this condition, cannot be determined accurately and for all cases, since different individuals are susceptible of pain and of the influence of narcotics in very different degrees. In ordinary cases, from forty to fifty drops of laudanum may be administered to an adult, fifteen or twenty minutes before the commencement of the operation, and this interval should be passed as quietly as possible.

It has long been known that nitrous oxide gas and the vapours of many vegetable narcotics produce, when inhaled, a degree of insensibility to physical suffering, and operations have been performed upon persons thus affected; similar results have been attained by the influence of animal magnetism. But the importance of these agents is slight, as compared with that of more recent discoveries, — the influence of inhalations of the vapour of sulphuric ether and of chloroform.

The applicability of the vapour of Sulphuric Ether to the purpose now under consideration, was first established by Dr. W. T. G. Morton, of Boston, on the 30th September, 1846. (See Report of the Mass. Gen. Hospital, Jan. 26th, 1848 — noticed in Am. Journ. of Med. Sc., April, 1848.) The influence of Chloroform in producing similar effects, was first determined by Professor Simpson, of Edinburgh. (See Am. Journal of Pharmacy, Jan., 1848.)

Since their effects became generally known, these agents have been employed to relieve pain in all sorts of operations, and in very many diseases; they have been administered, too, by the ignorant as well as by the learned, and without any discrimination of cases. It is not at all surprising, therefore, that in many instances injurious, and sometimes fatal, consequences have ensued. It would be out of place to discuss fully, in this volume, all the circumstances connected with the use of these agents. From the post-mortem examinations which have been had of persons who have died apparently in consequence of the inhalation of these vapours, it would seem that they produce death by asphyxia,—the lungs, the heart, the brain, having been found, in these cases, to be much congested, and the blood dark-coloured and more fluid than usual. The legitimate inference from these facts is, that these vapours should not be resorted to in persons suffering from congestion of these organs, or in whom any important disease of these organs exists. And although it may be admitted that a sufficient amount of testimony has been accumulated to show that the inhalation of these substances is not, under proper regulations and in well-discriminated cases, attended with material danger, and that it is even a valuable aid to the surgeon in many operations, it must also be acknowledged, on the other hand, that we have facts sufficient to prove that, without these precautions, and where the amount of pain to be experienced is not very great, these agents should not be used. It should be recollected that the mere performance of an operation, with comparative freedom from suffering to the patient and with satisfaction to the surgeon, is but one step towards the cure of the affection for which the operation is performed: the treatment of the patient subsequently is a matter of equal importance; and with reference to this part of the surgeon's duty, any cause which dis-

turbs the healthy play of important functions, whether it be the impression of too intense pain, or of too powerful narcotic agents, is to be regarded as an evil.

The vapour of chloroform is probably less safe than that of sulphuric ether, although it acts more promptly and in smaller quantity, — six or eight inspirations being sometimes sufficient. No precise rule can be laid down as to the quantity of the fluid, or the period of inhalation, necessary in either case to produce insensibility to pain, children and persons debilitated by disease, or other causes, being affected much more speedily than those in opposite circumstances. The vapour should be inhaled until the patient becomes insensible to pain, unless some unpleasant effect be produced before this condition is attained; and this insensibility should be prolonged, as may be necessary, by re-application of the apparatus to the mouth, from time to time, as the influence of previous inhalations passes off.

Many varieties of inhalers have been contrived for the administration of these vapours, some of them complicated and expensive; the object of all, however, is the same,—to allow atmospheric air to enter the lungs, loaded with the vapour of ether, or of chloroform. This end may be secured by using either of the inhalers illustrated by the accompanying wood-cuts, as perfectly as by the more complex apparatus. (Figs. 180 and 181.) Figure 180 represents a double-necked

Fig. 180.

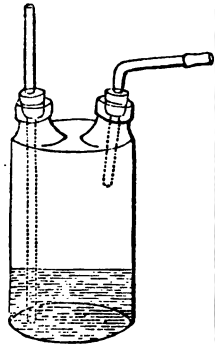


Fig. 181.



bottle into which the liquid is introduced; through one neck of the bottle, a glass tube passes, reaching below the level of the liquid; into the other a bent tube is inserted, through which the patient breathes. The tubes must be tightly fixed in the necks of the bottle, and the inspirations of the patient must be made through the bent tube, his lips firmly compressing the glass, the air expired from the lungs passing out through the nostrils. Figure 181 shows a common wide-mouthed bottle, having tightly fixed in the orifice a cork through which the tubes enter the bottle as in the other case, but it is not necessary to use any apparatus,—a sponge, or a piece of linen, wet with the liquid, and applied to the mouth, being fully as efficacious and more safe, inasmuch as a sufficient supply of atmospheric air is more certainly secured. The purest preparations only of ether and chloroform should be employed. Before commencing the inhalation of the vapour, the patient should be placed in the position most convenient for the performance of the operation, whatever it may be.

If any individual to whom these agents have been administered should not revive spontaneously, stimulating applications should be made to the surface, among the best of which is boiling water; this should be placed in a cup covered with a towel, and then the cup inverted upon the chest. (Amer. Jour. Med. Sc., p. 556, April, 1848.) Artificial inspiration should be resorted to, if other means fail.

The reader will find details as to the mode of preparing ether and chloroform in the Am. Journ. of Pharmacy, for Oct., 1847, and January and April, 1848. Numerous articles relating to their employment are contained in the Am. Journ. of Med. Sc. for 1847–8, to which reference should be made by those who may be disposed to test the action of these agents. Besides these publications, the author would recommend attention to the report of Dr. Isaac Parrish, of this city, to the College of Physicians, published in the "Transactions" of that body; to the essays of Dr. Warren, Dr. Simpson, and Mr. Miller; that of the latter being appended to the last edition of his Principles of Surgery.

CHAPTER IX.

ON GUNSHOT WOUNDS, TOGETHER WITH THE MORE IMPORTANT PECULIARITIES IN THE PRACTICE OF MILITARY SURGERY.

With a view of rendering this work more complete, and, also, more particularly suitable to the profession at the present time, the following chapter has been appended. While the principles of surgery are ever the same, the art of surgery must vary with the peculiar character of injuries, and also with the circumstances under which it is practised. By far the greater number of the injuries occurring in time of war, which are those from missiles projected by the force of explosion, called *gunshot wounds*, differ in many respects from those commonly treated in civil life, and the manner of treating injuries of every description is oftentimes necessarily very different from that usually adopted. It is the object of this chapter, therefore, to describe gunshot wounds and their treatment, and to point out the chief peculiarities in the practice of military surgery.

The cause of the peculiar character of a gunshot wound is the velocity with which a missile is projected by the force of the explosion of gunpowder. In consequence of this velocity the tissues are not simply torn, divided, or pushed aside, but they are contused to the highest degree; and it is this contusion, or crushing of the tissues, that gives rise to those phenomena which distinguish gunshot wounds from all others. These phenomena are: great lividity, more or less disorganization, remarkable dryness (owing to the absence of hæmorrhage, and to the presence of dead tissues), and a general perturbation and alarm, which is commonly called "shock." These primitive effects are followed by others of the most formidable character: the contusion produces intense inflammatory reaction, the loss of substance leads to abundant suppuration and to secondary hæmorrhages, and the splintering of the bones and opening of the articulations predisposes to tetanus and nervous delirium. As the projectile often remains in the body, or carries before it other substances, the presence of a foreign body, rare in other wounds, is here an ordinary phenomenon, which must be added to the others already enumerated. Another consideration, which must not pass unmentioned, is this, that a great number of persons often receive these wounds at the same time, and are

necessarily collected together, so that gunshot wounds are far more often attended, than any others, with hospital gangrene and purulent infection.

Although gunshot wounds have certain common characteristics, making of them a distinct class, yet they have numerous differences, arising from the velocity, the shape, and the size of the projectile, the course it takes in the body, and the nature of the parts with which it comes in contact. They will be modified also by the nature of the circumstances under which the patient happened to be placed, and by the condition of his health at the time of the receipt of the injury.

At the present day a large majority of the gunshot wounds with which the surgeon has to deal are caused by cylindro-conoidal balls, propelled with prodigious velocity from rifled weapons. The extreme swiftness and tapering form of these conoidal balls cause them to go through any organic tissue, no matter how dense and resisting, without deviation; and every portion of the body through which one of them passes is inevitably deprived of its vitality. The great power of resistance often exhibited by the yielding elastic tissue of the skin, by tendinous and other structures, of which most curious examples are related by military surgeons, is no longer of avail against projectiles from modern weapons. Scrive, in his "Medico-Chirurgical History of the Crimean War," relates that when soldiers were struck, creeping on the ground, these balls went straight from one end of a limb to the other, through the bones, without changing their direction. An English surgeon also relates that he has known the same ball to go straight through the bodies of two men, and lodge in a third.

The effect of the wedge-like form of these balls is most evident upon the bones. The round ball may be flattened against a bone, or turn round it, or only partly perforate it, but the conical ball is never seen to act in any of these ways. When it strikes a bone it splits it into fragments, having mainly a direction parallel to the long axis of the limb, and forms fissures extending into the joints. Any kind of ball, striking a bone about its middle, will generally fracture and split the shaft; but by the conical ball, the bone is rent so extensively that narrow fragments, many inches in length, are detached, and lesser portions are thrown in all directions, crosswise at the seat of fracture, and driven into the medullary canal and the neighboring soft parts. A surgeon, who passed through the Crimean war, says that he never knew a conical ball to mark a bone with any touch more gentle than what occasioned its utter destruction. It is obvious that the injuries inflicted by these balls, as those by any others, will be wider in proportion to their

greater size. If their diameter be about equal to that of the portion of the body struck, this will be completely cut off.

The introduction of rifled weapons, with conical balls, has not only increased the severity of gunshot wounds, but it has also greatly increased the number of the wounded in an engagement. This is a point which must not be passed unmentioned, for it is important to know what amount of surgical attendance may be required. Longmore says that Colonel Milford, chief instructor of the British government school of musketry, has stated that 80,000 rounds of ball-cartridges were fired from the old musket in one day in Caffraria, and only 25 Caffres were known to be killed; and at the battle of Salamanca, only one ball out of 3000, fired by the British, took effect; while at Cawnpore, one company of soldiers, armed with the Enfield rifle, brought down 69 out of a body of horsemen by whom they were attacked, at one discharge. At the battle of Solfarino, where rifled weapons were so extensively used, some returns show that, in 24 hours, 11,500 French, 5,300 Sardinians, and 21,000 Austrians, were laid *hors-de-combat.*

The effect of the improved fire-arms is dwelt upon here, because, as before mentioned, the great majority of the gunshot wounds the surgeon now has to deal with, are received from them, and also because it is only in the most recent publications that they are treated of. Another reason is that the wounds inflicted by them, present the peculiar characters of gunshot wounds in the highest degree, and when they are once understood, there can be no difficulty in understanding any others.

The wounds inflicted by pieces of shells, or by any penetrating missile of an irregular form, differ from those caused by balls, in being accompanied with greater laceration. They do not comminute bone so much as a rifle-ball, but tear the soft parts much more extensively. As their velocity is generally considerably less than that of more regularly shaped projectiles, they more often remain in the body.

The influence of the course of the ball and of the nature of the parts with which it comes in contact, upon a gunshot wound, must be described. When a ball strikes the soft parts very obliquely, it carries away the tissues it touches, and leaves a gutter-shaped wound. If nearly spent, the natural elasticity of the skin may enable it to yield to the strain to which it is exposed, and serious internal mischief may be inflicted, without there being any external marks of violence to indicate its having resulted from the stroke of a projectile. This is the kind of injury that in former times, was supposed to be owing to the *wind of the ball.* Cases are on record where portions of the clothing have been torn away

without injury to the wearer, and even hair has been shaved from the head, and the external ear and tip of the nose carried away without further mischief; so that the consequences attributed to windage must be erroneous. If the obliquity of the ball be less, it penetrates into the tissues, stopping among them or coming out again at a greater or less distance from the point of entrance. If the speed of the ball be great, and no bone have been struck, there is little difference in either the size or discoloration of the wounds of exit and of entrance; but if its velocity be less, so that it is retarded by contact with the tissues, and so have its speed considerably diminished before it passes out of the body, then the wound of exit will considerably exceed in size that of entrance. Macleod, in speaking of the characteristics of the two wounds, adds that in many cases the wounds of entrance are more regular and less discolored than those of exit, but, that the lips of the former were inverted, while those of the latter were everted, which has been stated by many writers, was seldom clearly marked to his observation.

Unless the ball be moving with great velocity when it enters the body, the tendons, especially if relaxed at the moment they are struck, are but little injured. Their toughness, elasticity, form, and stability, all assist in protecting them from being cut across or pierced. It is often deflected also by a strong aponeurosis, like that covering the outside of the upper portion of the thigh. The conical ball, however, as may be judged from what has already been said, is seldom so turned. The effect of balls upon the bony structures, can be judged from what has been already said when speaking more particularly of the improved fire-arms. That the nerves most commonly escape injury is a general remark of military surgeons, and it is owing probably to the manner in which they are enveloped, and to the facility with which they can be pushed aside.

The general absence of primary hæmorrhage in gunshot wounds, has been already noticed as one of their most striking phenomena, and the action of a ball upon the blood-vessels, is one of the most important and interesting points to be studied. The smaller vessels are crushed so that the blood is instantly coagulated near the spot where they were divided. The extreme readiness with which the larger arteries slip aside under pressure, the elasticity as well as toughness of their coats, and the fluidity of their contents, preserve them wonderfully in gunshot wounds, so that it comparatively rarely happens that they are cut across by a ball, whether round or conical. When the artery is firmly tied down or lying on bone, as the femoral where it passes over the brim

of the pelvis, the tibial where it lies on the head of the tibia, the lower parts of the radial and of the ulnar, and the facial where it turns over the jaw, it is much more subject to being injured then when loosely lying among the soft parts. Even when an artery is torn by a ball, no blood may follow; the lacerated ends of the middle and inner coats are retracted within the outer cellular coat; the calibre of the vessel is diminished, and tapers to a point near the line of division; it becomes plugged within by coagulum; and the cellulo-fibrous investing sheath, and the clot which combines with it, form on the outside an additional support and restraint against hæmorrhage. The veins are more easily cut by a ball than the arteries, and primary hæmorrhage when it does occur in a gunshot wound, generally comes from them.

Pain is not at all a prominent symptom in gunshot wounds. In simple flesh wounds, the patient will sometimes tell the surgeon that he was not aware when he was struck. A very common description of the sensation is that it resembles the effect of a smart blow from a supple cane. The parts in the neighborhood of the track of the ball are partially benumbed, as is seen by an examination causing much less pain immediately after its transit, than at any subsequent period.

When a bone is shattered, an important viscus injured, or a limb carried away, a general perturbation and alarm supervene, which is the so-called "shock" of a gunshot wound. The patient trembles, and his features express the greatest anxiety and distress. The skin becomes cold, and often of a leaden hue, the eye is fixed, the pupil dilated, the face pale, the respiration slow, the pulse extremely feeble, and the functions of the senses are deadened. The collapse and mental trepidation attending a gunshot wound, are frequently most appalling; and as a general rule they always very far exceed what is witnessed in injuries apparently of the same extent, inflicted in any other way.

Shock is very rarely absent in severe gunshot wounds, though most military surgeons relate instances where this was witnessed. Macleod states that he knew an officer who had both legs carried away, and who said that it was only when he attempted to rise that he became aware of the injury he had received. Guthrie states that at the battle of Talavera a soldier was struck on the head by a twelve-pound shot, "which stove some bone into, and some brain out of the head," and yet he was walking about, complaining but little, immediately after the accident, although he died subsequently.

The continuance of the shock should always make the surgeon fear that the mischief done is greater than what is apparent, and the prognosis given under such circumstances should be very guarded

The greater shock succeeding gunshot wounds of the lower extremities, than of the upper, has repeatedly been remarked, and is to be attributed, most probably, to the circumstance that the former sustain the weight of the body, while the arms are only suspended to the trunk, and yield to a certain extent to the impulse of the projectile. This explanation would coincide with the observation made by Macleod, that this difference was especially seen, if the person struck was in an erect position. The remark has been made by Chevalier, that the shock is always greater when the ball strikes a muscle in action than when it impinges against one which is relaxed. Though many explanations have been attempted of the greatness of the shock in gunshot wounds, none of them are fully satisfactory. Its effect is most injurious, for it is sometimes carried to such an extent, that the injured part may remain, as if dead, for several days, and then mortify, or the patient may even die.

Not only the primitive symptoms of gunshot wounds have a peculiar character, distinguishing them from all others, but their consecutive phenomena also require a particular description.

From the second to the fourth day inflammation commences about the wound, with a violence proportionate to the extent of the contusion, and accompanied with all the train of symptoms of traumatic fever. When no bone, nor large vessel, nor any important part, has been injured, the march of the wound is very simple: the tissues that have been destroyed become detached about the eighth or twelfth day, the pus, at first thin and bloody, takes on a more healthy appearance, granulations form, and the suppurating surfaces unite, the two openings closing last; and as a general rule, the one of entrance after the one of exit. Uncomplicated flesh wounds from gunshot usually heal in from five to six weeks.

When, however, the loss of substance is considerable, or a bone, or large nerve, or blood-vessel, has been injured, the consecutive phenomena are far from being so simple. The patient is oftentimes exhausted by the great and prolonged drain from the suppuration, or succumbs to an attack of erysipelas, or what is far more common, owing to the sojourn of pus among the tissues, falls a victim to purulent infection. When a bone is injured, fistulæ are established, lasting months and years, and only healing after the complete expulsion of all the necrosed portions. As said before, by modern weapons, the bone is almost always splintered, and, so soon as sensibility returns to the parts, the fragments driven into the muscles produce excruciating pain, and most violent spasmodic contractions. If they remain in the wound, these

fragments interfere subsequently with the consolidation of the fracture, and cause profuse suppuration. It occasionally happens, moreover, that they are driven into the medullary cavity of the long bones, and render fruitless every effort to save the limb. When a joint is opened, by a gunshot wound, the most intense inflammatory reaction is excited, often followed, when the large joints are interested, by fatal consequences.

Hæmorrhage, which is rare as a primary symptom in gunshot wounds, is on the contrary of common occurrence among the consecutive phenomena. It takes place, generally, about the time of the separation of the sloughs; or, generally, from the eighth to the twelfth day. It might be supposed that by this time the obliteration of the vessel would be complete, but it is probable that the inflammation following gunshot wounds is of such violence as to interfere with this process. The quantity of blood lost in these secondary hæmorrhages is proportionate to the size of the vessel from which it pours; it may be so considerable, and the flow so rapid, as to destroy life before any assistance can be rendered to the patient. At other times a clot forms, favored by the state of syncope into which the patient falls, and the hæmorrhage is thus checked for a time. If efficacious means are not then resorted to, this hæmorrhage almost always returns a second and a third time from the displacement of the clot, until finally the patient dies. Gunshot wounds are also rendered particularly subject to secondary hæmorrhage from the frequent presence of a foreign body, as a fragment of bone, or any other hard, rough, or pointed substance, which by prolonged pressure gradually produces ulceration through the walls of an artery.

From the injuries to nerves, atrophy of tissues and contraction of muscles, with impaired power of resisting cold, are very frequent consequences of gunshot wounds. Sometimes a foreign substance lodges in and continues to irritate the nerve, and the wounded part becomes so painful as not to be borne; the nerve at that part forms a tumour of a most painful character, requiring removal, or in extreme cases even the amputation of the extremity. If the nerve of a limb be completely divided, complete loss of power of motion and sensibility will be the result. Tetanus, which is one cause of fatal termination in gunshot wounds, is most commonly due to some local injury to the nerves, producing irritation along their course, and so leading to some morbid condition of the ganglionic portions of the motor tracts of the spinal cord. Sir G. Ballingall made the calculation that one in every seventy-nine cases of gunshot wound is attacked with tetanus, and states that the proportion of recoveries is so small as scarcely to be taken into account.

A complication of gunshot wounds which, on account of its frequent occurrence and the serious symptoms to which it gives rise, requires particular notice, is the presence of foreign bodies. Besides those constituted by fragments of broken and splintered bone, which have already been mentioned, the projectiles themselves are often arrested among the tissues, and they carry before them the wadding of the gun, fragments of the dress, buttons, or any other substances they may encounter on their passage. Gravel and small stones struck up by shells at the time of their explosion, or by shots ricochetting against the ground, often penetrate the body; and fragments of shells, if projected edgeways, according to Longmore, almost invariably lodge. It is of great importance to detect the presence of these foreign bodies, and to do so is often a matter of extreme difficulty.

If the wound made by a ball shows two openings, it is probable that it no longer remains in the body; but the two openings may have been made by two separate balls, or, as is not at all of rare occurrence, the ball may have been split by a ridge of bone in two or more fragments, of which only one has found an exterior issue. Macleod says, that he does not believe the conical ball, with its immense force of propulsion, can be thus split; but we have been informed by Dr. Hammond, that in 14 cases of wounds from conical balls, received at the skirmish of Falling Waters, and admitted into the hospital of Hagerstown under his care, the ball was split in every one; in one instance it was split into seven pieces, in another into three. Again, the presence of only one opening does not afford positive proof that the ball has remained in the body; for it sometimes merely pushes before it the clothing, without tearing it, and, after having penetrated the soft parts to a considerable distance, falls out again. Guthrie relates a case where a ball, which penetrated the surface of the chest, and passed under the pectoral muscle for two inches, was ejected by the elasticity of the rib against which it struck; and also another, where a hole three inches in depth was made in the thigh by a ball that came out with a portion of the shirt.

Wadding, pieces of metal, portions of the clothing, and all similar foreign bodies, pushed by a ball into the body, generally penetrate only a short distance, and are easily found and extracted.

Large projectiles are but seldom found in the wound they have occasioned, though instances are related by military surgeons where this occurred. Larrey found in the groin a five-pound ball, which had not before been detected, though the patient had been examined by several surgeons. Sanson extracted from the upper and inner part of the thigh one weighing nine pounds. Hennan

mentions a case as having occurred at Seringapatam, in which a spent twelve-pound shot buried itself in the thigh of an officer, and so little appearance was there of a body of such bulk, that he was brought to the camp, where he soon expired, without any suspicion of the presence of the ball till it was discovered on examination. Longmore relates a case where a grape-shot weighing one pound and two ounces lodged in the back of the pharynx and escaped observation for three weeks. Macleod states, that he saw a piece of shell weighing nearly three pounds extracted from the hip of a man, which had been overlooked for a couple of months. Were it not for the experience of many such instances, it would be supposed impossible that foreign substances such as these could remain for any length of time in the body without being discovered, and these few are related in order to show the difficulty that may attend their diagnosis.

The treatment of gunshot wounds is composed of general and local means, and, as will be known from the description just given, demands an acquaintance with all the resources of surgery, and consummate skill in their application. A concise account, however, of the more important of these means — those that are most generally employed and recommended by experienced military surgeons — will now be given.[1]

The general treatment is indicated by the natural course of the symptoms. While the shock lasts, stimulants are required; the period of inflammatory reaction calls for local and general antiphlogistics; and that of suppuration for tonics and corroborants. But the agents composing the treatment prescribed for each of these periods must always be employed with great prudence; the stimulants should be sufficiently active to arouse the patient, but never so violent as to provoke intense inflammatory reaction; the antiphlogistics — necessary when this reaction is produced — must

[1] For the purpose of having the means of rendering the first assistance necessary to wounded men immediately at hand, in the French service, the surgeon carries a small sack, slung at his side, into the field. Something of the kind could very advantageously be introduced into our own. We have been shown, by Mr. Jacob Dunton of this city, a small wallet, planned by himself, which could be thus carried, with little or no inconvenience to the surgeon. The wallet is 6 inches broad and 6 inches long, by 1½ inches deep, and is slung by a strap passing over the left shoulder. It contains a large-sized pocket case with three folds, a flask of brandy, and four bottles holding tincture of opium, aromatic spirits of ammonia, solution of persulphate of iron, and chloroform. A side pocket holds lint, strips of isinglass plaster and a field tourniquet. When complete it weighs two pounds and three ounces, and its appearance is quite ornamental. Not only the surgeon in the French service carries one of these sacks, but every officer is furnished with one, in which he carries little things necessary to his comfort.

always be used with caution and in moderation, in order not to lower the forces of the patient, which will be so severely taxed during the long-continued suppuration; and during the period of suppuration the same prudence is necessary in the use of corroborants, to avoid increasing the general inflammatory symptoms. During the continuance of the shock, the patient is to be kept warm, stimulants — such as wine, brandy, ether, or ammonia — are to be given in small quantities. mustard poultices or flying blisters applied to the extremities, and, in some circumstances, stimulating injections must be administered. When reaction sets in, strict attention must be paid to diet, mild purgatives given, and occasionally, though very rarely, bleeding, local or general, had recourse to. Finally, during the period of suppuration the patient should have an abundance of food, rich in nourishment and easy of digestion, and at times a moderate supply of malt liquor, wine, or brandy. The tendency, generally, is to overfeed during this latter period, and a remark of Hennan may well be borne in mind in regard to it, he says: "The character of a young man stands high with the soldiers in proportion to the extent of extras on his diet-roll, but the success of his practice is *invariably in an inverse ratio.*"

In the local treatment, in case amputation or excision of the part injured be impossible, or not advisable, if there be any considerable hæmorrhage, this must first of all be attended to. Should this proceed from a wounded artery of considerable size, even on the battle-field, the tourniquet should not be trusted to for its arrest, but the bleeding vessel itself is to be secured by ligature, and both ends are to be tied as directed at page 296. It may here be mentioned that the application of the tourniquet by uneducated men is most objectionable, and a better plan is to direct them, when bleeding is observed, to place a finger in the wound, and keep it there until the aid of a surgeon is obtained. The precise spot where compression by the finger is wanted, and the amount of pressure necessary, will be speedily seen by the effect produced on the flow of blood. When the bleeding is of the kind known as *en nappe*, or a general oozing from a multitude of small vessels, the means recommended at page 282 are to be had recourse to. In addition to the styptics there described may be mentioned the solution of the persulphate of iron, which has been recently introduced into surgical practice, and is decidedly the most efficacious hæmostatic known.

As soon as possible, while the sensibility of the adjacent parts is numbed, and before they have become swollen, the wound should be carefully examined, to learn the extent and nature of the injury

inflicted, and to detect any foreign bodies that may be lodged. This examination will be greatly facilitated by placing the wounded parts as nearly as possible in the position they occupied, when struck by the missile. In the upper extremity this is particularly important, for it is liable on account of its use, to be struck in very different positions from the one occupied when the patient is at rest, with the arm hanging at his side. In this way all the tissues will be in the same condition of tension or of relaxation, and present the same relative position one to the other, as when the projectile passed through them. The surgeon also should place himself relatively to the patient in a position to correspond as nearly as possible with the direction from which the ball came. The celebrated Ambrose Paré, as Percy says, acquired great reputation in this way, for by attention to this precept, when called to attend Monsieur de Brissac, grand-master of the artillery, when wounded at the siege of Perpignan, he found just under the skin, lower than the scapula, the ball which several surgeons had been unable to find, and which they declared had penetrated the chest, because they had neglected to place themselves in the proper position. Guthrie relates an instructive case of a soldier whose foot was gangrenous without any apparent cause, he having received merely a flesh wound in the thigh, not in the course of the femoral artery. On placing the man in the same position with regard to himself, however, that the man supposed himself to have been in toward the enemy when wounded, the possibility of an injury to this vessel was seen, and dissection after death proved that this had occurred. It is obvious that the less a ball deviates from its straight course, the greater is the advantage resulting from this attention to the position, and hence it is more than ever to be insisted upon since the introduction of conoidal balls and rifled weapons. Longmore, Macleod, and other surgeons who have passed through modern campaigns, lay more stress upon this point than others who have written previously. Longmore says that "in almost every instance the examination will be facilitated by attention to this precept;" and Macleod says, that "the great point to attend to undoubtedly is the fulfilment of this rule."

The best of all instruments for examining the wound is the finger of the surgeon; the fore-finger is the most convenient, but if the opening will not admit of this, the little finger can be substituted. Unless the wound be very unusually deep, the finger will reach sufficiently far, particularly if the parts are pressed towards it by the disengaged hand. The finger disturbs the parts less than anything that can be used; it detects the presence of pieces of clothing and of wadding, that would probably be con-

founded with the soft parts by any other instrument, and it gives far more accurate information as to the shape, length, position, number, and degree of looseness of splinters of bone, or of any other foreign bodies. When the wound is so narrow or so deep that the finger will not answer, recourse should be had to a long, stout, metallic probe, or to a female catheter, which is very generally recommended in these explorations, as its shape preserves it from becoming entangled and arrested among the tissues. In parts, however, connected with life, or liable to be seriously injured, it is but very rarely that explorations with anything but the finger are ever admissible.

If a foreign body is detected, its nature, form, position and relations must be examined, in order to decide whether it is to be extracted or allowed to remain, and whether it is to be removed by the orifice of the wound or by a counter-opening. On account of the nervous and inflammatory symptoms caused by the presence of a foreign body, in the early stages of gunshot wounds, and the long continued and exhausting suppurations it keeps up, it should always be immediately removed, so soon as found, unless its extraction requires very extensive incisions, risking the injury of important parts, or would cause more serious mischief than the presence and after-effects of the foreign body itself. The position of a ball under a fascia, or in contact with a bone, Macleod says, should make us risk much in order to remove it.

For the removal of wadding, pieces of clothing, and such like bodies, which seldom penetrate far, the finger either alone, or aided by a probe, generally suffices. In some cases, however, a pair of dressing forceps will be demanded, or one of the instruments, for the extraction of balls, described below.

When the wound has been received at a very short distance, it often presents a complication, which, though not serious, is very disagreeable, particularly as it is only seen in uncovered parts of the body, namely, the incrustation of unburnt grains of powder in the thickness of the skin. These are to be removed without delay, each grain patiently picked out by the point of a needle, otherwise when the openings made in penetrating the skin have entirely cicatrized, there is no way of remedying the deformity.

For the removal of balls, the means already mentioned will generally prove sufficient; but in certain circumstances, particularly when the wound they have made is very deep and narrow, other instruments are required. Those represented on page 362 will probably be found the best.

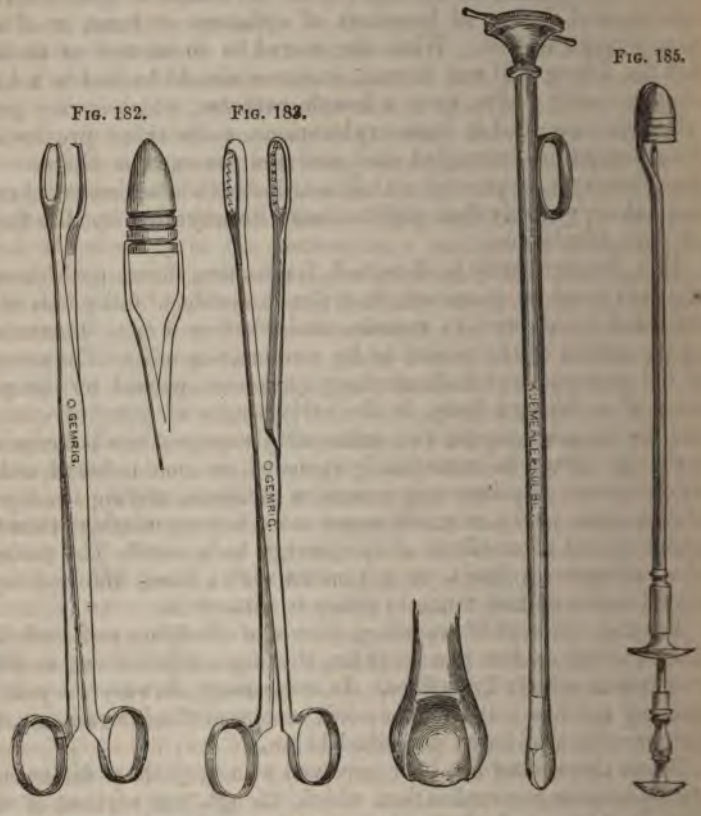
From the comparatively limited space required for its action, the extractor, represented by Fig. 185, and which corresponds to

Fig. 184.

Fig. 185.

Fig. 182.

Fig. 183.



the celebrated *tribulcon* of Baron Percy, will be found very convenient. Instruments of two blades, with the ordinary hinge-like motion, dilate the wound injuriously and painfully before they can be expanded to grasp the ball. When the ball has become impacted in bone, it must be removed by a steel elevator; or if this is insufficient, it must be gouged out.

When a foreign body has passed nearly through a limb, and can be felt on the other side through the flesh, or when it lies at the bottom of a narrow and crooked wound, that could not be straightened and enlarged without endangering nerves and arteries, a counter-opening should be made for its extraction. In making such an incision the surgeon must be careful to raise the parts and cut into the centre of the fold, otherwise the pressure

of the bistoury in dividing the parts may push the ball back into the more deeply-seated tissues.

Another point to be mentioned is that the surgeon who has not had experience in such matters often finds the extraction much more difficult than he expected, because he has made his incision too small. He must always cut freely.

In removing conical balls, fragments of shells, or any bodies of irregular shape, the greatest care must be exercised to remove them with their smallest diameter presenting to the orifice. Fragments of splintered bone, when loose, or when nearly detached, are always to be removed, except when the injury is in the face. In this region, every structure receives so large a supply of blood, that pieces of bone are enabled to resume their full connection with the other parts, in a very extraordinary manner. Hence, all spicula should here be left, whose attachment has not been completely destroyed, and whose direction is not opposed to a proper union of the broken parts.

In all cases where the extraction of a foreign body is attended with great difficulty and danger, the surgeon should recollect that it may be loosened by suppuration and gradually approach the skin, or may even become encysted, and remain without causing pain or mischief. By bearing this fact in mind, he will be less apt to persist in making dangerous efforts at extraction.

After all the foreign bodies that can with prudence be extracted have been removed from the wound, the blood must be washed away, the lacerated and misplaced parts adjusted and held in place by strips of adhesive plaster, or what answers very well, strips of wet linen, a suitable position adopted, and the dressings applied. In these applications, as Longmore directs, pressure, weight, and warmth must be avoided as much as is possible consistent with the end in view. What has been said above of the nature of gunshot wounds must be borne in mind, that they are wounds contused to the highest degree, and therefore no effort is to be made to bring about union by first intention; healing is to take place by the slow process of granulation and cicatrization. The best primary application, as a general rule, is cold water, in the form of irrigation, as described at page 52. When the means of applying cold water in this way are not available, a strip of wet lint should be used and kept constantly moistened by water dropped upon it. The cold water should be continued so long as cold is grateful to the patient. When it ceases to be so, it should be exchanged for warm, applied in any convenient way, as by wet lint, simply covered by oiled silk to prevent evaporation. Dr. Gross recommends in the dressing of the wound that a roller

should be carried up from the distal end of the limb to some distance beyond the seat of the injury, with a view of facilitating the union of the sides of the wound by adhesive action.[1] Union by adhesive action, in gunshot wounds, is, however, as may be supposed from what has been said of their nature, of such rare occurrence, that it is never to be thought of. Some two or three examples of such an event are recorded by military surgeons, and then only as surgical curiosities. Guthrie, whose advice is always the result of sound judgment and vast experience, so that it cannot too often be quoted on all subjects pertaining to military surgery, says a few inches of a linen bandage may be sewed on, over the wet lint, to prevent it from changing its position during sleep, and adds that "a roller, as a surgical application, is useless, if not injurious."

After suppurative action has been fully established, the surgeon must be guided, in the local treatment of gunshot wounds, by the general rules applicable to all wounds healing by granulation (see page 303). It should be remarked, however, that though poultices may often be used most advantageously in civil practice, they should seldom be permitted in a military hospital. Guthrie says of them that they are generally cloaks for negligence, and sure precursors of amputation in all serious injuries of the bones and joints.

In former days it was the invariable practice of all surgeons to commence the treatment of gunshot wounds by incising their edges. This was done to facilitate the discharge of sloughs, pus, and foreign bodies, and to prevent the development of excessive inflammatory swelling, leading to gangrene of the tissues, burrowing of the pus, and denudation of the bones and tendons. At the present day, except to aid in the search for a bleeding vessel, or in the extraction of a foreign body, this practice is not so generally adopted, and indeed by English and American surgeons it is almost entirely abandoned. Macleod speaks of it as "the exploded custom of scarifying the wound." This change is owing to the teachings of Hunter, who says that "no wound should be opened because it is a wound, but because there is something necessary to be done which cannot be executed unless the wound is enlarged." To remedy hæmorrhage and to extract a foreign body, according to Hunter, a gunshot wound might be enlarged, but never to prevent swelling of the parts or to facilitate the discharge. By the French military surgeons these incisions are more commonly made, in consequence probably of their being more impressed with the authority of Larrey, who applied those incisions,

[1] A System of Surgery, 2d edition, vol. i. page 338.

or *débridemens*, as they are called, to almost every wound. Scrive states that, in the Crimean war, "the real benefits of the preventive dilatation of wounds were demonstrated by the favourable results that followed the practice of removing constriction by long and deep incisions:—its advantages in remedying strangulation, excess of inflammation, the stagnation of pus, and traumatic gangrene, were seen in numerous instances." Whatever opinion be held in regard to this preventive *débridement*, there can be no question as to the propriety of scarifying the wound after inflammation has set in, if the tension of the parts be great, for the purpose of loosening the fascia, taking away blood from the part immediately affected, and of making a free opening for the liquids effused. To do this a finger should be introduced into the wound, if it be large enough; if not, it must be previously enlarged upon a director, so that the finger can be admitted. A probe-pointed bistoury must be carried with its side along the finger as far as may be judged proper, into the wound, and then withdrawn with its cutting edge turned up so as to divide the muscles, fascia, and skin, to the extent of several inches. The finger is introduced in this way into the wound to detect the presence of large nerves and blood-vessels, which it is very important to avoid. Again, in the subsequent stages of gunshot wounds, when the pus has burrowed among the tissues and the sinuses are slow in healing, the practice is no less advantageous, and even when this is not the case, but the parts are simply unhealthy, Guthrie admits that a free incision is often very serviceable.

As stated before, secondary hæmorrhage is not uncommon in gunshot wounds, and it is, at times, one of their most annoying and dangerous complications. Guthrie says that it does not *often* occur of any importance from small vessels; on the separation of the contused parts, or sloughs, a little blood may occasionally be lost, but it is then generally caused by the impatience of the surgeon, or the irregularity of the patient, and seldom requires attention. From the larger arteries, he says it sometimes occurs from their giving way by ulceration between the eighth and twentieth days, but the proportion is not more than four cases in a thousand requiring the application of a ligature, exclusive of those formidable injuries caused by broken bones, or the inordinate sloughing caused by hospital gangrene, when not properly treated. By others secondary hæmorrhage is spoken of as occurring far more frequently than it would appear to have occurred in the experience of Guthrie. It should, at all events, be the object of particular attention on the part of the surgeon, above all if the situation of the wound and the course of the ball render it pro-

bable that a large vessel has been injured. Under such circumstances it is well to have a tourniquet (see page 288) placed above the wound, and an attendant should watch by the patient to be ready to tighten it as soon as the hæmorrhage appears, as it may prove fatal before the surgeon can reach the spot.

Secondary hæmorrhage is said to arise from increased arterial action, from the first to the fifth day; from sloughing, the effects of contusion, from the fifth to the tenth; and from ulceration at any more distant date. Baudens states that he has observed it to be most frequent about the sixth day after the receipt of the injury; and he attributes this to the traumatic fever having then reached its highest point of intensity, and the sharp, hurried contractions of the heart having most power in forcing out the coagula.

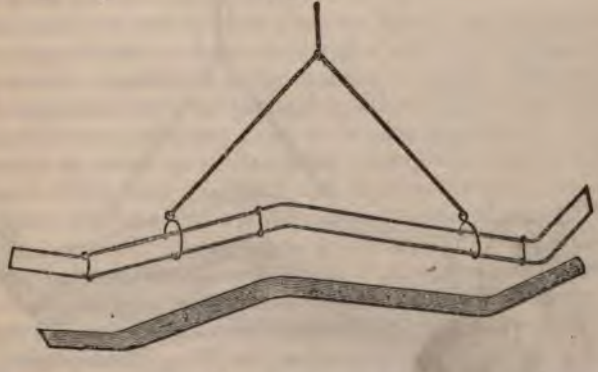
The treatment in secondary hæmorrhage should be the same as that advised for primary; that is, oozing from the smaller vessels is to be checked by the application of the solution of the persulphate of iron, called Monsel's solution; and bleeding from a large vessel, by tying it at the wounded part, a ligature being applied both above and below the point of injury, whenever this is practicable. Until within a few years, all surgeons were afraid to apply a ligature to an artery in an inflamed wound, supposing it would cut its way immediately through the coats of the vessel, or fall prematurely. It has however been shown by Nélaton, in a Memoir contributed to the Academy of Medicine in 1850, that these fears were groundless, and that, though under such circumstances the ligature falls sooner, yet the external coat of the artery is not divided when the thread is tied, and the vessel is as surely obliterated as when its ligation is practised in a fresh wound. Macleod, from the results of cases which fell under his observation in the Crimean war, gives his testimony to the soundness of these views of Nélaton, which, when more generally known and practised upon, must save many limbs and lives; for in obstinate cases of consecutive hæmorrhage in a wound of the extremities, unless a ligature can be applied both at the upper and lower end of the divided vessel, amputation, or ligation of the principal vessel, between the wound and the heart, are the only two resources left. Of the value of the latter resource, or ligature of the principal artery above the wound, Guthrie says: *Whenever the collateral circulation is sufficient to maintain the life of the limb, blood must pass into the artery below the wound, and must as a general rule pass up and out through the lower end of the divided artery, unless prevented by the application of a ligature or by some accidental circumstance, forming an exception to the rule but not the rule itself.*

There are two other points of the utmost importance to be borne

in mind in regard to secondary hæmorrhage in a wound. The first is that as the closure of the lower orifice of a divided artery is less perfectly accomplished than of the upper, it is more likely to suffer from secondary hæmorrhage; and the other, that, particularly in the inferior extremity, where the collateral circulation is not so free as in the superior, the blood flowing from the lower end of the artery is venous in colour, and wells out in a continuous stream, and not with an arterial impulse.

For an account of the different apparatus to be used in order to keep the parts in proper position, in gunshot wounds of the extremities, with injury of the bones, during the process of their cure, we would refer to what is said in previous pages of this volume on the subject of compound fractures. Since these pages were written, however, the apparatus known as the anterior suspensory apparatus, the invention of Prof. N. R. Smith, of Baltimore, has been introduced into surgical practice; and, we have been assured by military surgeons, it has been found so admirably adapted to their requirements, in the treatment of gunshot injuries of the lower extremities, that it must here be described. A piece of wire, of the thickness of a No. 10 bougie, is bent twice at a right angle, at each extremity, so as to form a frame three inches wide at one end, two inches and three-quarters at the other, and three feet eight inches long. Along the length of this frame, at distances of about eight inches from each other, side pieces are firmly clenched.

Fig. 186.



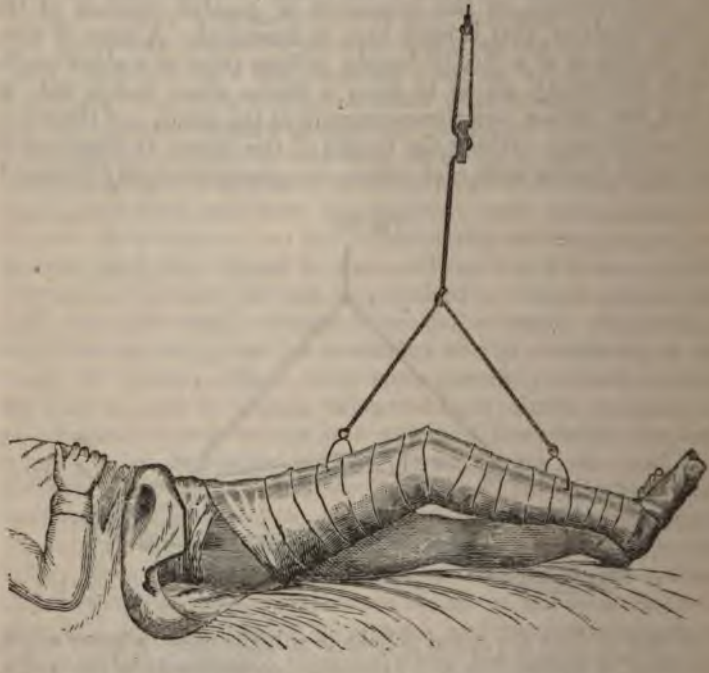
When this is done the splint is bent to suit the case; a lower angle, bent about 6 inches from the extremity, corresponds to the ankle, and should be about 120°, to hold the foot in an easy position, an upper angle, for the hip, should be of about the same degree,

but one inch farther from the end; the angle at the knee should be more obtuse, or about 160°. These angles are readily made by bending the splint over the top of a chair, or the edge of a bed, and they can easily be varied, as is often necessary, to suit particular fractures.

When the splint is thus shaped, as represented at figure 186, it is to be tightly wrapped with a muslin bandage, and it is ready for application.

The suspensory apparatus is simple, and easy of application. A small iron pulley is to be screwed into a support above the bed, or, if the patient is to be transported, into the bow of the ambulance, so as to be perpendicularly over the middle of the shin, or nearly so. A cord, about as thick as the wire of the splint, passes over the pulley, and is reeved through a small tent-block, as seen in figure 187, by which, slipping it upward or downward,

FIG. 187.



the limb can be elevated or depressed. Through a loop in the end of the cord, another cord, about five feet in length, and having

at each end a double hook attached, is passed, and hangs double from the loop by its centre. On each side, about the centre of this double cord, guys of india rubber should be attached, and fastened to the sides of the ambulance, when the wounded man is to be transported. To apply the apparatus, the limb is to be adjusted, and the splints carefully laid along its upper surface. Strips of adhesive plaster, or bands soaked in starch, are to be passed, one over the foot and around the splint, another around the ankle, another beneath the knee, a fourth above the knee, and a fifth around the thigh, near the hip. The hooks of the suspensory apparatus are now to be applied to the wire frame, as represented in the cut, and the limb is gently raised, so as to hang suspended in the slings. The requisite dressings can now be applied to the wounded parts, and a roller bandage may be loosely applied, so as not to obstruct the free issue of matter.

This apparatus of Dr. Smith is not only extremely comfortable to the patient, but it possesses the great advantage of allowing the surgeon to have free access to the seat of injury, without removing any of the essential supports of the limb. It may be safely recommended as the best apparatus that can possibly be used in the treatment of gunshot wounds of the lower extremity.[1]

In compound fractures of the limbs, however, from a gunshot wound, the injury received is generally so great from extensive splintering of the bones and opening of the joints, as to demand, in order to save life, either the resection of a portion of the osseous tissues, or amputation of the limb.

When, from the nature of the injury, or the circumstances of the case, amputation is the only resource, the rule taught by long and invariable experience is to operate at once. Military surgeons everywhere are now agreed upon this point, that, in their practice, with the single exception of amputations at the hip-joint, the success of primary amputations constantly exceeds that of secondary. The results of their experience on this point have always been the same, and their conclusions, after recent wars, are similar to those previously acquired.

Larrey often declares that even the shock is relieved by the removal of the injured part; and he relates that, of three men whose two legs were amputated by him after the battle of Wagram, the one first operated upon, only a few moments after the shot, was the only one saved. Hennen strenuously insists that the wounded limb must be removed with *as little delay as possible*. Scrive states

[1] For a full description of this admirable apparatus, of which a mere outline can here be given, we must refer to the American Journal of the Medical Sciences for April, 1861.

that, in the Crimea, the proportion of the success of the primary amputations surpassed, sometimes one-half, sometimes two-thirds, the favourable results of consecutive amputations. Macleod also says that the experience in the Crimea was, as it has always been, unequivocal in favor of early amputation; and goes so far as to declare — in this agreeing with Larrey — that in place of merely advocating interference within twenty-four hours, "the prevailing idea at present would be better expressed by saying that, every hour the operation is delayed, diminishes the chances of a favorable issue."

There is a second point connected with the subject of amputation, in extensive gunshot injuries of the limbs, where experience has shown that the practice of the military surgeon must be different from that which ought to be followed in civil life. In civil practice, in doubtful cases, the attempt should always be made to save the limb; in military practice the limb should always be amputated. Such a precept sounds most harshly, but it is so universally maintained by all who have had military experience, that it is unquestionably correct. Hennen tells us that "*the sum of human misery will be most materially lessened by permitting no ambiguous cases to be subjected to the trial of preserving the limb;*" and, notwithstanding the improvements made in surgery in the last half century, the same statement is still made. "If," says Scrive, "you hesitate in cases that appear doubtful, or if you place yourself a little too much on the ground of what is called conservative surgery, you are not long in repenting of it, and in seeing wounded men die in consequence of wounds that often amputation would have been able to save." One great cause of the mortality attending compound fractures of the limbs, in the British army in the Crimea, was, according to Macleod, undoubtedly the great striving after conservatism, which influenced all the surgeons of the British army.

In performing the operation of amputation, is is well to remember that in soldiers there is commonly but little subcutaneous fat, and the muscles are large and strong; hence, it becomes very difficult, when practising the flap operation, to adapt the parts to one another so as to fulfil the latter part of the old maxim, "muscle must cover bone, and integument muscle." As regards the question of the respective advantages of the circular and the flap operation, it would seem that the former mode of operating is more advantageous in military practice than the latter, as allowing the patient to be removed with far more safety. Long, heavy flaps become loose, get bruised, and finally slough.

In all other points but these, the practice of military surgeons

in the treatment of injuries of the limbs in which their amputation may be demanded, corresponds to that recommended for civil practice in the best modern treatises.[1]

In certain cases of compound fractures from gunshot wounds excision of the joints and resection of portions of the bone may be preferred to amputation, as exposing life to less danger, or securing a more useful limb. What these cases are, we shall state as briefly as possible, founding our conclusions entirely upon the results of the experience of military surgeons.

In the upper extremity, the results of excision of the shoulder and elbow joints, have been exceedingly satisfactory. In the Schleswig-Holstein campaigns great attention was paid to resection of the joints, and the results have been published by Esmarch in a very valuable essay on this subject. Of 19 patients in whom the shoulder joint was resected, in 12 a useful arm was preserved, and 7 died. In not a single instance did complete anchylosis occur, and in several the power of motion became so great, as to enable men to perform heavy work. Of 40 patients for whom resection of the elbow joint was performed, 6 died, and 32 recovered with a more or less useful arm; one remained unhealed when Esmarch wrote his essay (1851), and in one mortification ensued and amputation was performed. The experience of the surgeons engaged in the Crimean war, is also, on the whole, decidedly favorable to excision of these joints of the upper extremity, and it may be laid down as a rule, that although they may be much injured, yet, when the principal vessels have escaped unhurt, the articular surfaces and broken portions of bone are to be removed, and an attempt made to preserve the limb.

In the upper extremity, resections, also, after gunshot wounds, succeed very well. When the bone is much splintered, the detached portions, and any fragments that only hold by slight periosteal connections, should be removed, spicula that project should be cut or sawn off, and a free opening should be made, if none exists, at the most dependent place.

In the lower extremity, owing to a smaller supply of blood, a less free anastomosis between the vessels, the greater drain there is upon the system during the period of reparation, and the constrained and irksome position the patient must retain during the treatment, the results of these operations are far less satisfactory. When either the knee or ankle joint is implicated, amputation of the limb must be performed. The knee joint was excised once in the Crimea, but the patient died, and the same result followed in

[1] See Gross, *op. cit.* vol. i. chap. xvii., and vol. ii. chap. xxii.

the only other instance in which this was done for gunshot injury in the Schleswig-Holstein Campaign. In the Crimean war, when ever resection of portions of the femur was practised, every case without exception proved fatal. In the bones of the leg, when neither the ankle nor the knee joints were implicated, the results of resection were more favorable. When both the tibia and fibula were injured, nearly 19 per cent. recovered; when the tibia alone, 36.3 per cent.; and when the fibula alone, 40.9 per cent. At the hip joint, according to the experience of the Crimean war, excision has certain advantages over amputation. Out of 23 cases of amputation, performed in the French and English armies, not one recovered, and nearly all died very shortly after the operation. Out of 6 cases of excision, one recovered entirely, one survived a month, and all lived, in comparative comfort, for a considerable time.

In the recent campaign in Italy, Longmore states that in the lower extremity the practice of conservative surgery was almost entirely abandoned.[1]

The experience obtained in recent wars in regard to the use of anæsthetics in the practice of military surgery is so decidedly favorable that it does not seem proper to conclude this chapter without adding some of the results of this experience to what has been said of such agents in Chapter VIII. By Macleod it is stated that during the whole Crimean war, he never had reason, for one moment, to doubt the unfailing good and universal applicability of chloroform in gunshot injuries, if properly administered. He adds again that he most conscientiously believes that its use in the British army directly saved very many lives; that many operations necessary for this end were performed by its assistance which could not otherwise have been attempted; that these operations were more successfully because more carefully executed; that life was often saved even by the avoidance of pain; the *morale* of the wounded better sustained, and the courage and comfort of the surgeon increased.

Scrive, the surgeon-general of the French forces in the Crimea, says that the benefits derived from the use of chloroform were immense; and although it was used in thousands of cases, that it never caused the slightest serious accident. It was used not only to obtain complete insensibility in every important operation, but also to render more supportable the pain of wounds altogether

[1] For the manner in which these operations of excision of the joints, and resection of portions of the bones, are to be performed, we would refer to *Chapter* xviii., vol. i., and Chapter xxi., vol. ii., of the work of Dr. Gross, *before* cited.

desperate, and to calm nervous and irritable persons in whom the dressing of their wounds caused much suffering. It is stated in addition by Scrive, that great resistance of the wounded to anæsthesia a day or two after the reception of the injury was frequently remarked. A much larger dose of chloroform was then necessary before insensibility was produced, and the period of excitement was so strongly marked that several men were often required to hold the patient. To avoid this over-excitation produced by traumatism, the rule was observed to amputate as far as possible the very day of the receipt of the wound. When consecutive amputation was necessary on account of gradual sinking from profuse suppuration, anæsthesia was effected with the most perfect tranquillity. It must be concluded, therefore, that the advantages derived from the use of anæsthetics are even more evident and more appreciated in military than in civil practice.

APPENDIX OF FORMULÆ.

THE following list of formulæ will be found to contain many which have been proved to be valuable in answering the indications for which they are directed.

LOTIONS.

I. ASTRINGENT LOTIONS.

1. Wash for secondary venereal ulcers, particularly of the throat—

℞. Cupri sulphatis, ℈ij,
Pulv. cinchonæ, ℥ss,
Aquæ fluvialis, f℥viij.
M. ft. lot. — Dr. Physick.

2. ℞. Tinct. myrrhæ, f℥j—f℥ss,
Aquæ fluvial., f℥viij.
M. ft. lot.

3. ℞. Creasotæ, gtts. xx—gtts. l,
Aquæ fluvial., f℥vj.
M. ft. lot.

4. ℞. Tannin ℈j,
Spt. vini gallici., f℥ss,
Mist. Camphoræ, f℥vss.
M. ft. lot.—For salivation, spongy gums, &c.

5. ℞. Sodii chlorid., (sol.)
Tinct. myrrhæ, āā f℥ss,
Aquæ fluvial., f℥iv.
M. ft. lot. — Uses the same as the last.

II. STIMULATING LOTIONS.

6. ℞. Acidi nitrici, fʒj—fʒij,
Aquæ fluvial., fʒviij,
Aquæ rosæ, fʒj.
M. ft. lot.

7. ℞. Ammoniæ muriat., ʒj—ʒij,
Aquæ fluvial., fʒviij,
Tinct. opii, fʒj.
M. ft. lot. — For painful indolent ulcers.

8. ℞. Acid. cyanhydrici, ♏j,
Mucilag. acaciæ, fʒviij,
M. ft. lot. — To relieve the itching in prurigo.

9. ℞. Hydrarg. chlorid. mit., ʒij,
Liquoris calcis, ʒviij.
M. ft. lot. — "The black wash."

10. ℞. Hydrarg. bi-chlorid., grs. x—℈j,
Liquoris calcis, ʒviij.
M. ft. lot.

11. ℞. Spt. vini rectificati,
Tinct. camphoræ, āā fʒiijss,
Liquor. plumbi, fʒj.
M. ft. lot. — To be rubbed upon the part several times daily, occasionally suspending it. For indolent fibrous tumours of the breast. — Brodie.

12. ℞. Iodini ℈j,
Potassii iodid., ʒss,
Aquæ fluvial, fʒviij
M. ft. lot. — For application to scrofulous and other indolent tumours.

III. EVAPORATING AND REFRIGERANT LOTIONS.

13. ℞. Ammoniæ mur., ʒj,
Potassæ nitrat., ʒij,

Vinegar, f℥j,
Aquæ fluvial., f℥x.
M. ft. lot. — Schmucker's frigorific mixture.

14. ℞. Ætheris sulphuric.
Alcohol,
Aquæ plumbi, āā f℥j.
M. ft. lot.

15. ℞. Sodii chloridi,
Potassæ nitratis,
Ammoniæ muriat, āā ℥ij,
Aquæ fluvial., q. s. ad mist. solvend.
M. ft. lot. — Druitt.

16. ℞. Spt. vini rectif., f℥j,
Aquæ fluvial., f℥vij.
M. ft. lot.

CERATES.

17. ℞. Resinæ, ℥j,
Cer. flav., ℥ij,
Adipis, ℥v.
M. ft. cerat. — For burns. — Physick.

18. ℞. Cerat. plumbi, s'acet.,
Cerat. simplicis, āā ℥ss,
Hydrarg. chlor. mit.,
Pulv. opii, āā ℥j.
M. ft. cerat. — For burns, painful ulcers, &c.

19. ℞. Unguent. hydrarg. nit., ℥j,
Cerat. simplicis, ℥iij—℥ss.
M. ft. cerat. — For sore nipples, &c.

20. ℞. Pulv. camphoræ, ℈j—℥j,
Cerat. simpl., ℥j.
M. ft. cerat. — A stimulating salve.

21. ℞. Hydrarg. chlorid. mit., grs. vj,
Pulv. opii, grs. x,
Cerat. simpl., ℥ij.
M. ft. cerat. — For indurated chancres.

22. ℞. Acid. hydrocyanic, gtts. xx,
Cerat. simpl., ℥ij.
M. ft. cerat. — For papular eruptions attended with itching.

23. ℞. Creosotæ, gtts. xx,
Cerat. simpl., ℥ij,
Zinci oxid., ℥j.
M. ft. cerat. — For scaly eruptions.

OINTMENTS.

24. ℞. Potassæ carb., ℥ss,
Aquæ rosæ, f℥j,
Hydrarg. sulph. rubr., ℥j,
Ol. bergam., f℥ss,
Fl. sulphuris,
Adipis, āā ℥ix.
M. ft unguent. — Bateman's aromatic sulphur ointment, for itch, &c.

25. ℞. Picis liquid, f℥j,
Salt butter, ℥ij,
Melt together, and add of
Common potashes, ℥j,
Gräfe's itch ointment.

26. ℞. Unguent. hydrarg. fort., ℥j,
Antimon. et potass. tart., ℥j,
Iodini, grs. x—xv.
M. ft. unguent.—To be rubbed upon the part daily, until it pustulates. For chronic glandular tumours, old indurated buboes, &c.—R. Johnson.

27. ℞. Morphiæ acetat. grs., vj,
Pulv. gallæ, ℥j,
Unguent. stramonii, ℥j.
M. ft. unguent.—For hæmorrhoids.—Harlan.

28. ℞. Sodæ bi-carb., ℥j,
Adipis, ℥j,
Pulv. opii, ℈j.
M. ft. unguent.—For lichen, prurigo, &c.

LINIMENTS.

29. ℞. Ol. tiglii., f℥ss,
Ol. cinnamomi, f℥j,
Ol. olivæ, f℥j,
Lin. cantharid, f℥ij.
M. ft. liniment.—for neuralgia.—Prof. Jackson.

30. ℞. Ol. olivæ,
Alcohol āā, f℥j,
Tr. camphoræ, f℥ss,
Aquæ ammoniæ, f℥j.
M. ft. liniment.—For indurated breasts.

31. ℞. Ol. terebinth,
Ol. lini āā Oss,
Ol. succini,
Ol. juniperi āā f℥iv,
Petrol. Barbadensis, ℥iij,
Petrol. American, ℥j,
M.—"The British Oil." To be used diluted with olive oil, or lard, as a stimulating liniment, or ointment.

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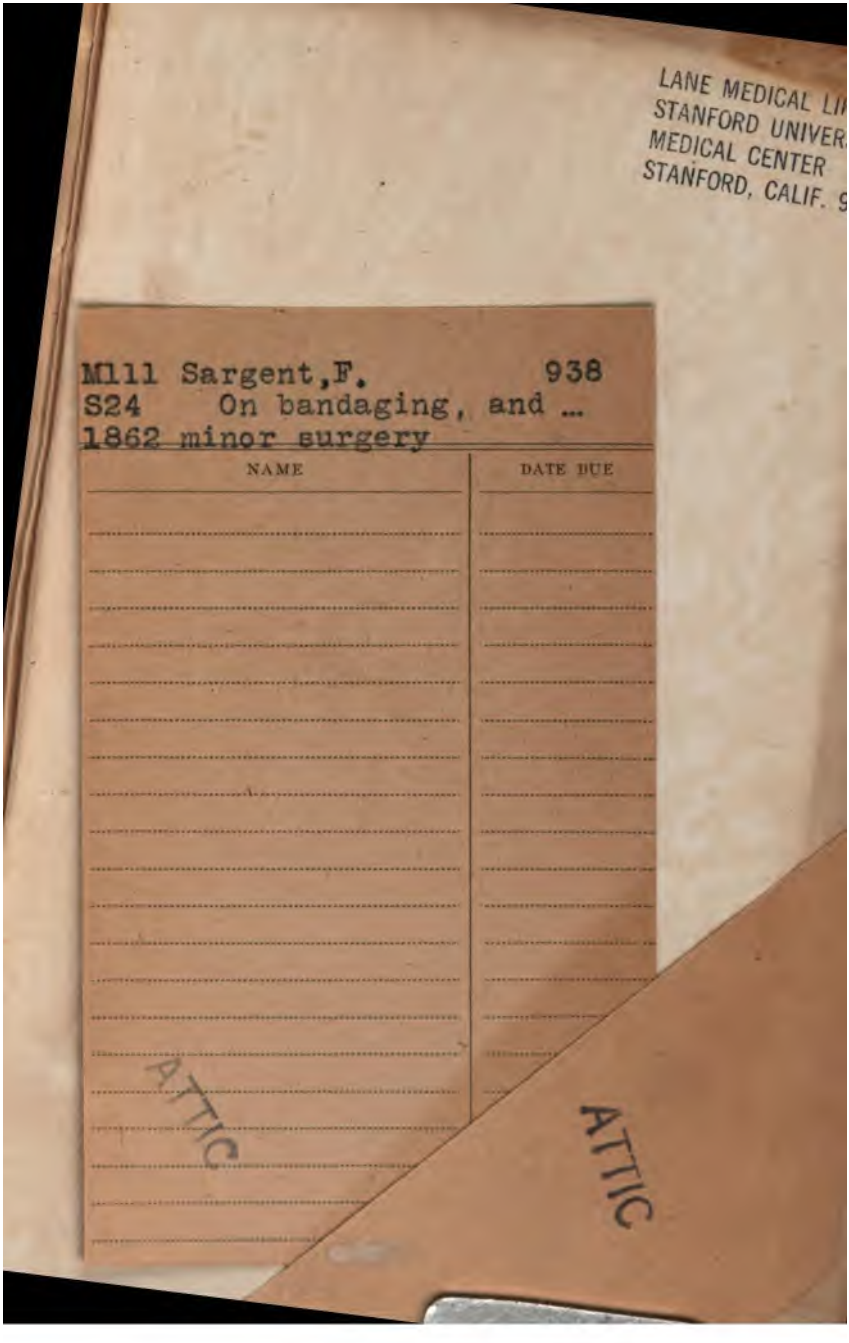
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